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UNITED STATES DEPARTMENT OF THE INTERIOR

HAROLD L. ICKES, Secretary

BUREAU OF MINES

JOHN W. FINCH, Director

# MINERALS YEARBOOK

# 1939

Compiled under the supervision of

H. HERBERT HUGHES

Economics and Statistics Branch

UNITED STATES

GOVERNMENT PRINTING OFFICE

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# FOREWORD

In Minerals Yearbook, 1939, the Bureau of Mines presents an economic review and statistical summary of the mineral industry of the United States in 1938. This annual service was inaugurated in 1866 and since 1925 has been the principal function of the Economics and Statistics Branch of the Bureau of Mines. In the performance of its duty this branch of the Bureau endeavors to supply producers and consumers of mineral products, as well as the general public, with as much factual data as is possible with the limited funds appropriated for this purpose. Every effort is made to maintain the high standard of accuracy that has prevailed in the past, and at the same time to publish the finished volume at the earliest possible date. In view of the tremendous importance of mining to the industrial life of the United States, the constantly increasing difficulty of finding new deposits and maintaining production from old ones, and the growing realization of the significance of minerals in international affairs, the necessity for official fact-finding of the type presented in this series of publications cannot be overemphasized.

Unfortunately, the year 1938 was a poor one for the mineral industry. The industrial recession that began the latter part of 1937 continued at an accelerated rate in the first half of 1938. With production schedules geared to 1937 requirements, stocks mounted rapidly as sales fell abruptly; prices declined accordingly. In some commodities midyear inventories exceeded or approached the depression highs established in 1932 and 1933. Prices, however, did not reach the distress levels of 1932. During the last half of 1938 there was substantial improvement. Sales increased appreciably, and curtailment programs begun earlier in the year were effective in cutting down production. Stocks again declined and prices regained most of the losses incurred during the first 6 months. At the close of the year the outlook was considerably brighter than at the beginning.

The national defense aspects of minerals received considerable attention during 1938, and legislation authorizing the purchase of war-reserve stock piles of the relatively few minerals that the United States obtains abroad was introduced in Congress. In keeping with its policy of presenting timely and useful information, the Economics and Statistics Branch has summarized the domestic situation on the more important deficient strategic minerals in this issue of the Yearbook.

The Bureau's activity in collecting marketing statistics was extended in 1938. The annual survey of consumption of pig iron and iron and steel scrap, begun in 1935 on a temporary basis, was established permanently as a result of an appropriation granted by Con-



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gress in response to requests from industry for continuation of this work. The results of the survey for 1938 are included in a separate chapter entitled "Scrap Iron and Steel" in Minerals Yearbook, 1939. This volume likewise includes for the first time statistics on the sales of barite by consuming industries and a survey of kerosene consumption.

The practice, adopted last year, of issuing the separate chapters of the Yearbook as preprints as soon as they are completed, was well-received by the public and is being continued this year.

JUNE 23, 1939. JOHN W. FINCH, *Director.*

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# INTRODUCTION

Despite sharp declines in production of virtually all important minerals the record of the mineral industry in 1938 was better than that of business in general. The index of the Federal Reserve Board for minerals was 98, a drop of 15 percent from 1937, whereas the combined index for all industry was 86, a drop of 22 percent.

The preliminary total value of mineral production in the United States in 1938, as reported to the Bureau of Mines by producers, was $4,354,000,000, a decrease of 20 percent from $5,413,600,000 in 1937. Metals, as a group, showed the sharpest decline—40 percent—followed by mineral fuels, with a drop of over 12 percent and nonmetals with nearly 12 percent.

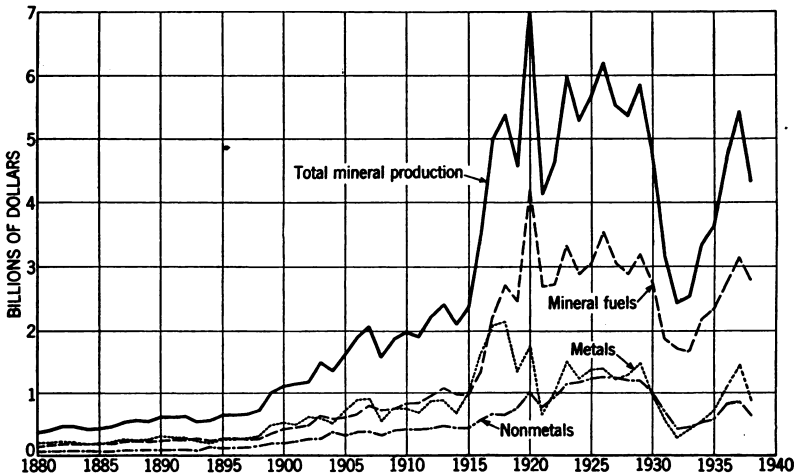


FIGURE 1.—Mineral production of the United States, 1880-1938.

Gold was outstanding among the principal minerals, in that production in 1938 increased appreciably from 1937. Aluminum output was only 2 percent below 1937, but copper, lead, and zinc dropped from a third to a fifth below 1937 levels and, largely as a result of smaller production of base metals, silver output also declined. The depressed condition of the steel industry was responsible for a drop of 61 percent in iron ore production, and most of the other minerals used in steel manufacture—fluorspar, fluxing stone, coke, and alloying metals—showed similar declines. Molybdenum was the notable exception, for production again increased in 1938 although shipments were lower than in 1937.

The relatively mild winter of 1938 as well as low industrial activity resulted in a drop of 23 percent in bituminous coal and lesser declines in output of anthracite, petroleum, and natural gas. Natural gasoline production increased slightly. The output of the building



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materials group—cement, stone, sand and gravel, gypsum, lime, and clay products—in general was roughly 10 percent lower in 1938 than in 1937, although total slate production was slightly higher owing to increased demand for granules. The conspicuous exception to the general downward trend of the other nonmetals was bromine, production of which again rose to a new record.

*Strategic minerals.*—The mounting interest in strategic and critical materials culminated early in June 1939 with the passage of an act—

To provide for the common defense by acquiring stocks of strategic and critical materials essential to the needs of industry for the manufacture of supplies for the armed forces and the civilian population in time of a national emergency, and to encourage, as far as possible, the further development of strategic and critical materials within the United States for common defense.

This act carries authorization for the appropriation of $100,000,000 during 4 fiscal years beginning July 1, 1939, for procuring stock piles of strategic commodities. Obviously, this sum is not adequate to establish emergency supplies of all deficient minerals or other materials, but the legislation marks the first major peacetime effort to meet the strategic-material problem. The bill also authorizes the appropriation of $500,000 annually for 4 years to the Department of the Interior for an investigation of domestic resources of deficient strategic minerals with a view to developing production therefrom. Of the sum authorized, $350,000 is to be expended by the Bureau of Mines and $150,000 by the Geological Survey.

The Army and Navy Munitions Board late in 1938 defined strategic materials as "those essential to the national defense for the supply of which in war dependence must be placed in whole, or in part, on sources outside the continental limits of the United States, and for which strict conservation and distribution control measures will be necessary." Ten of the 17 commodities included on the list of strategic materials are of mineral origin, as follows: Aluminum, antimony, chromium, manganese (ferrograde ore), mica, nickel, quartz crystal, quicksilver, tin, and tungsten.

The Board defined critical materials as "those essential to the national defense, the procurement problems of which in war, while difficult, are less serious than those of strategic materials because they can be either domestically produced or obtained in more adequate quantities or have a lesser degree of essentiality, and for which some degree of conservation and distribution control will be necessary." Nine of the 20 commodities classified as critical materials are of mineral origin, as follows: Asbestos, cadmium, cryolite, fluorspar, graphite, iodine, platinum, titanium, and vanadium.

The Bureau of Mines has occupied an important position in the investigation of the deficient-minerals problem. A member of the staff has served prominently on each of the 17 commodity committees, appointed by the Assistant Secretary of War. John W. Finch, Director of the Bureau, and J. W. Furness, Chief, Economics and Statistics Branch, prepared an analysis of the strategic-mineral problem. They summarized their findings as follows:

Despite the costly experiences of the World War the industrial preparedness program of the United States still contains a major weakness by reason of its failure to provide adequate supplies of our deficient minerals for use in time of stress. While the situation in some commodities has improved since 1918, it has become more acute in others. The United States is no longer dependent on foreign sources for nitrates, potash, and platinum, for example, and domestic production of a few other commodities has been expanded. On the other hand, exhaustion

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of higher grade ore bodies, as in the case of mercury, and the tremendous increase in the use of such essential metals as tin, manganese, chromium, tungsten, and aluminum has increased our dependence on foreign sources of supply for these commodities. Deficient minerals, therefore, still constitute a major problem in national defense.

Two methods of solving this problem have been suggested: The purchase of stock piles of strategic minerals to be held in reserve for military and civilian uses in an emergency, and the stimulation of domestic industries by tariff protection or other subsidies.

Congress adopted the second method in 1922 when it established an import duty on manganese ore, but during 14 years of protection ranging from 50 to 100 percent ad valorem, only 5 percent of our metallurgical requirements were supplied from domestic sources. As a result of this experience with tariff stimulation and the present need for strengthening national defense, the value of the stock-pile method is receiving wider recognition. The purchase of a manganese stock pile was advocated in the annual report of the Secretary of War for 1927 and the Naval appropriation bills for the past 2 years have included small sums for the purchase of reserve supplies of strategic minerals.

The Bureau of Mines believes that the purchase of stock piles of standard-grade materials is the first step in providing a safe solution of the deficient-mineral problem and recommends immediate action in this direction. It is realized, however, that it would be impractical to obtain stock piles large enough to safeguard the nation in a prolonged war and for this reason domestic resources must be considered as a supplementary source of supply in emergency. The Bureau recommends, therefore, that a national inventory of domestic deposits be undertaken at once by appropriate government agencies and that a carefully prepared plan be developed for exploiting these deposits in time of need. If adopted, this two-point program will guarantee adequate supplies of essential raw materials and thus assure the completion of the industrial mobilization plans to be inaugurated in the event of war.

It is indeed gratifying that the recommendations of the Bureau have been adopted virtually unchanged in the legislation providing for stock piles. Many of the historical data assembled during this study are included in the chapters of this volume, thereby establishing their permanence for future reference.

*Minerals Yearbook series.*—Minerals Yearbook, 1939, continues the progress made in Minerals Yearbook, 1938, in presenting final data for the year under review by including complete final statistics for metal mining in Arizona. A new chapter on scrap iron and steel has been added. Only the chapters on bituminous coal, coke, petroleum, natural gas, and natural gasoline are based on preliminary data for 1938.

The practice of issuing preprints of separate chapters in advance of the bound volume was introduced last year. It met with widespread favor and is being continued this year; 48 chapters have been printed and distributed. This procedure was adopted with some misgiving because of its potential lowering effect on sales of the bound volume. This apprehension proved to be unfounded for total circulation of Minerals Yearbook, 1938, was more than 9,000 copies, and the sales edition was exhausted several months before the appearance of the present volume.

*Acknowledgments.*—By act of Congress the collection of production statistics of the bituminous-coal industry previously conducted by the Bureau of Mines was transferred to the National Bituminous Coal Commission July 1, 1937. Although the Coal Commission did not conduct a canvass of production for 1937 comparable to earlier years, the statistical record of the industry, maintained by the Geological Survey and the Bureau of Mines since 1880, remains unbroken for the Commission has prepared a chapter for this volume based on data from various sources. Preliminary data for 1938 also are given. The

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cooperation of the Coal Commission in contributing this chapter is gratefully acknowledged.

Presentation of data on imports and exports in Minerals Yearbook is made possible through the cooperation of the Bureau of Foreign and Domestic Commerce.

The statistical program of the Bureau of Mines depends entirely on the good will and voluntary cooperation of those interested in mining. It is a pleasure to acknowledge the general support of thousands of individual mine operators, distributors, and consumers, as well as the many public officials and agencies that have returned questionnaires or otherwise supplied information. In addition, the Bureau is indebted to a large number of trade associations for liberal contributions and advice.

In the collection of mineral statistics in several States the Bureau of Mines receives the formal cooperation of the State geologist or comparable State official. This arrangement eliminates duplication of canvasses by the State and Federal Governments and, through field contacts of the State officials, tends to improve the accuracy and coverage of the production data. State agents cooperating in the 1938 canvass were: Walter B. Jones, State geologist, University, Ala.; Herman Gunter, State geologist, Tallahassee, Fla.; Garland Peyton, director, and Richard W. Smith, geologist, division of mines, mining, and geology, Department of Natural Resources, Atlanta, Ga.; M. M. Leighton, chief, and Walter H. Voskuil, mineral economist, State Geological Survey Division, Urbana, Ill.; A. C. Trowbridge, director, Iowa Geological Survey, Iowa City, Iowa; Raymond C. Moore, State geologist, Lawrence, Kans.; Edward B. Mathews, State geologist, Baltimore, Md.; R. A. Smith, State geologist, Lansing, Mich.; H. A. Buehler, State geologist, Rolla, Mo.; Meredith E. Johnson, State geologist, Trenton, N. J.; Charles C. Adams, director, D. H. Newland, State geologist, and C. A. Hartnagel, assistant State geologist, New York State Museum, Albany, N. Y.; H. J. Bryson, State geologist, Raleigh, N. C.; Robert H. Dott, director, Oklahoma Geological Survey, Norman, Okla.; E. P. Rothrock, State geologist, Vermillion, S. Dak.; E. H. Sellards, director, bureau of economic geology, Austin, Tex.; Arthur Bevan, State geologist, and Linwood H. Warwick, chief clerk, Geological Survey, Charlottesville, Va.; Harold E. Culver, supervisor, division of geology, department of conservation and development, Pullman, Wash.; and E. F. Bean, State geologist, Madison, Wis. In addition, Walter W. Bradley, State mineralogist, San Francisco, Calif., assisted in the compilation of statistics for California.

In addition to preparing the statistical summary of mineral production each year Martha B. Clark has been largely responsible for the maintenance of continuity of data and uniformity of statistical presentation throughout the Minerals Yearbook volumes.

Elva T. Shuey served as editorial associate in reviewing and checking chapters, and Max Abel assisted in the administrative details of the Yearbook program. The illustrations for the volume were prepared in the graphic section of the Bureau under the direction of Louis F. Perry. Mabel E. Winslow supplied helpful suggestions for improving individual contributions and, in collaboration with Eleanor C. Reid, was responsible for the editing of the entire manuscript.

H. HERBERT HUGHES.

JUNE 23, 1939.

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# PART I. SURVEY OF THE MINERAL INDUSTRIES

## STATISTICAL SUMMARY OF MINERAL PRODUCTION

(GENERAL UNITED STATES SUMMARY AND DETAILED PRODUCTION BY STATES)

By MARTHA B. CLARK

SUMMARY OUTLINE


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| Changes in form of presentation | 1 | State tables | 14 |
| Unit of measurement | 2 | | |
| Elimination of duplication | 2 | | |


### INTRODUCTION

This report continues the series of annual statistical summaries published in previous years as chapters of Mineral Resources and Minerals Yearbook.

#### CHANGES IN FORM OF PRESENTATION

A change, which it is believed is most desirable, has been made in the first two tables of this summary in the form of presentation. In the first table all minerals produced are listed separately under metallic or nonmetallic, and the entry "Unspecified", given in earlier chapters of this series, has been eliminated. In the second table this change has been carried back through 1880, the first year of record. For years beginning with 1914 the breakdown of "Unspecified" into metallic and nonmetallic has been based on actual figures; prior to 1914 the distribution has been made arbitrarily—divided equally—as no figures are available for closer separation.

Attention is called also to a change in presentation of figures for the clay industry for 1936, 1937, and 1938. As no figures are available for the total clay produced, earlier chapters of this series included in both United States and State totals the total value of clay products and excluded the value of the clay sold as such by producers. The Bureau of Mines, however, believes that a closer approach to the value of domestic clay in its first marketable form will result from the inclusion of the value of clay sold by producers and of clay products other than pottery and refractories. The change has been made in this chapter in the United States totals for 1936 to 1938 and in the State totals for 1936 and 1937. It should be borne in mind when comparing these values with those for earlier years.



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## UNIT OF MEASUREMENT

The unit of measurement used by the Bureau of Mines for each mineral product in reports on the mineral resources is that common to the industry concerned, and the variation in these units makes it impracticable, if not impossible, directly to combine and compare the different minerals except as to value. Although most of the products are measured by weight, some are measured by volume, some by number of "pieces," etc., and for some no total quantity figures are available.

## ELIMINATION OF DUPLICATION

In the totals for the United States, shown in the following "general" tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production which is included in the totals. For asphalt, both native and oil are shown in the general tables, but the value of the oil asphalt is excluded from the totals as it duplicates that of the petroleum from which it is manufactured.

*United States totals.*—In the general tables both iron ore and pig iron are shown, but the value of the pig iron rather than the iron ore is included in the United States totals, as that is considered the better means of presenting the statistics for iron in its first marketable form. For gold, silver, copper, lead, and zinc the value of "smelter output" is included in the general totals, and to account more fully for the value of the ores treated these smelter figures are supplemented by the value of the byproduct sulfuric acid. The value of pigments (white lead, red lead, lithopone, litharge, and orange mineral) manufactured from metals is not included in the general tables, as the base from which they are made is included in the output of lead or zinc, whereas the value of sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide is included, as these are made in large part direct from the ores and do not enter into the lead or zinc totals, which represent smelter output.

*State totals.*—In the State tables also iron ore and pig iron are both shown. As blast-furnace products cannot be traced to the States in which the ore is mined, the value of the ore is used in the State totals. For ores of gold, silver, copper, lead, and zinc no values are shown, and in fact none are recorded; instead, for each of these metals the recoverable content of the ores is used as the basis of valuation. The value of the zinc and lead pigments is not included in the State total, as the recoverable zinc and lead content of the ores from which the products were made is included under zinc or lead. The value of the sulfuric acid produced as a byproduct of copper and zinc smelting and zinc roasting is not included in the State total, as tracing this product back to the State producing the ore has not been possible.

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# GENERAL TABLES

## *Mineral products of the United States, 1936–38* [1]

[See second and third paragraphs of this chapter]

| Product | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value |
| **METALLIC** | | | | | | |
| Aluminum—pounds | 224,929,000 | $41,612,000 | 292,681,000 | $55,609,000 | 286,882,000 | $56,659,000 |
| Antimonial lead—short tons (2,000 pounds) | [2] 23,230 | (3) | [2] 27,524 | (3) | [2] 24,123 | (3) |
| Antimony: | | | | | | |
| Metal—do | 3,451 | (3 4) | 4,057 | (3 4) | (3 4) | (3 4) |
| Ore and concentrates—do | 3,867 | (5) | 4,250 | 137,600 | 2,730 | 61,510 |
| Bauxite—long tons (2,240 pounds) | 372,005 | 2,198,523 | 420,232 | 2,444,686 | 311,354 | 1,812,545 |
| Cadmium—pounds | 3,633,495 | 2,889,000 | 3,995,739 | 4,555,000 | 3,753,323 | 2,815,000 |
| Chromite—long tons | 269 | 2,978 | 2,321 | 14,888 | 812 | 10,730 |
| Copper,[6] sales value—pounds | 1,222,819,396 | 112,499,000 | 1,669,322,278 | 201,988,000 | 1,124,656,539 | 110,216,000 |
| Ferro-alloys—long tons | 853,531 | 69,135,074 | 970,651 | 86,140,492 | 464,112 | 41,811,513 |
| Gold [7]—troy ounces | 4,357,394 | 152,508,800 | 4,804,540 | 168,158,900 | 5,089,811 | 178,143,400 |
| Iron: | | | | | | |
| Ore [4]—long tons | 51,465,648 | [4] 131,740,594 | 72,347,785 | [4] 207,828,213 | 26,430,910 | [4] 74,322,405 |
| Pig—do | 30,798,958 | 541,693,504 | 35,224,347 | 731,139,435 | 18,202,354 | 356,875,369 |
| Lead (refined),[6] sales value—short tons | 387,698 | 35,668,000 | 443,142 | 52,291,000 | 331,964 | 30,541,000 |
| Magnesium (new ingot)—pounds | 3,903,312 | (5) | 4,539,980 | (5) | 4,819,617 | (5) |
| Manganese ore (35 percent or more Mn)—long tons | 32,119 | 696,400 | 40,241 | 1,062,399 | 25,321 | 681,679 |
| Manganiferous ore (5 to 35 percent Mn)—do | 940,519 | 2,235,366 | 1,340,972 | 3,857,768 | 308,860 | 858,356 |
| Mercury: | | | | | | |
| Metal—flasks (76 pounds net) | 16,569 | 1,324,194 | 16,508 | 1,488,691 | 17,991 | 1,357,781 |
| Ore—short tons | (8) | (9) | (8) | (9) | (8) | (9) |
| Molybdenum—pounds | 17,959,000 | 11,933,000 | 30,122,000 | 20,571,000 | 25,727,000 | 17,977,000 |
| Nickel—short tons | 107 | (5) | 219 | (5) | 416 | (5) |
| Ores (crude), old tailings, etc.: | | | | | | |
| Copper—do | 38,505,000 | (9) | 61,640,000 | (9) | (10) | (9) |
| Dry and siliceous (gold and silver)—do | 16,949,000 | (9) | 17,355,000 | (9) | (10) | (9) |
| Lead—do | 3,898,000 | (9) | 5,670,000 | (9) | (10) | (9) |
| Lead-copper—do | 2,000 | (9) | 2,000 | (9) | (10) | (9) |
| Zinc—do | 11,098,000 | (9) | 12,693,000 | (9) | (10) | (9) |
| Zinc-lead—do | 8,889,000 | (9) | 10,651,000 | (9) | (10) | (9) |
| Zinc-lead-copper—do | 73,000 | (9) | | | (10) | (9) |
| Platinum and allied metals (value at New York City)—troy ounces | 46,946 | 1,968,000 | 45,258 | 2,114,000 | 36,213 | 1,263,000 |
| Selenium—pounds | 226,402 | (5) | 282,598 | (5) | 166,494 | (5) |
| Silver [11]—troy ounces | 63,812,176 | 49,422,530 | 71,941,794 | 55,646,978 | 62,665,335 | 40,510,924 |
| Tantalum ore—pounds | | | 16,307 | 13,317 | 36,189 | 35,127 |
| Tellurium—do | 25,453 | (5) | 23,365 | (5) | 26,944 | (5) |
| Tin (metallic equivalent)—short tons | 113 | 105,000 | 189 | 205,300 | 122 | 103,200 |

See footnotes at end of table.

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*Mineral products of the United States, 1936–38*—Continued

| Product | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value |
| METALLIC—continued | | | | | | |
| Titanium ore: | | | | | | |
| Ilmenite, short tons | [5] | [5] | [5] | [5] | [5] | [5] |
| Rutile, do | [5] | [5] | [5] | [5] | [5] | [5] |
| Tungsten ore (60-percent concentrates), do | 2,612 | $2,323,818 | 3,500 | $4,094,000 | 3,044 | $3,161,498 |
| Uranium and vanadium ores, do | 75,738 | [5] | 131,080 | [5] | 231,687 | 898,779 |
| Zinc,[6] sales value, do | 491,803 | 49,180,000 | 551,165 | 71,651,000 | 436,007 | 41,857,000 |
| Other metallic[12] | | 1,114,037 | | 852,105 | | 907,612 |
| Total value of metallic products (approximate) | | 1,081,600,000 | | 1,468,200,000 | | 891,800,000 |
| NONMETALLIC | | | | | | |
| Arsenious oxide, short tons | 15,581 | 618,826 | 17,636 | 541,555 | 13,160 | 393,022 |
| Asbestos, do | 11,064 | 314,161 | 12,079 | 344,644 | 10,440 | 247,264 |
| Asphalt: | | | | | | |
| Native, do | 581,064 | 3,260,895 | 485,384 | 3,019,038 | 512,147 | 3,065,260 |
| Oil (including road oil) [4], do | 3,607,603 | [4] 31,790,935 | 3,844,326 | [4] 36,670,827 | 4,249,226 | [4] 34,572,918 |
| Barite (crude), do | 283,160 | 1,674,631 | 355,888 | 2,240,970 | 309,663 | 2,004,521 |
| Borates (naturally occurring sodium borates and colemanite (calcium borate)), short tons | 313,759 | 6,156,123 | 358,898 | 7,232,897 | 219,513 | 4,570,316 |
| Bromine, pounds | 20,609,025 | 4,038,438 | 26,200,256 | 5,180,177 | 32,324,116 | 6,610,056 |
| Calcium-magnesium chloride, short tons | 125,911 | 1,909,908 | 101,547 | 1,295,403 | 103,930 | 1,218,938 |
| Cement, barrels (376 pounds net) | 114,610,972 | 172,777,698 | 115,678,182 | 171,414,093 | 108,069,668 | 156,535,303 |
| Clay: | | | | | | |
| Products (other than pottery and refractories) [13] | | 95,136,775 | | 109,175,963 | | [13] |
| Raw (sold by producers), short tons | 3,782,428 | 13,423,456 | 4,237,386 | 15,708,064 | 2,730,861 | 11,775,572 |
| Coal: | | | | | | |
| Bituminous [14], do | [15] 439,087,903 | [15] 770,955,000 | [15] 445,531,449 | [16] 864,042,000 | [15] 344,630,000 | [16] 655,000,000 |
| Pennsylvania anthracite, do | 54,579,535 | 227,003,538 | 51,856,433 | 197,598,849 | 46,099,027 | 180,600,167 |
| Coke [4], do | 46,275,184 | [4] 232,373,991 | 52,375,469 | [4] 261,003,903 | 32,633,304 | ([4] [10]) |
| Diatomite, do | [17] | [17] | [17] | [17] | [17] | [17] |
| Emery, do | 325 | 2,900 | 320 | 2,780 | | |
| Feldspar (crude), long tons | 244,726 | 1,303,090 | 268,532 | 1,383,249 | 196,119 | 895,081 |
| Fluorspar, short tons | 176,877 | 3,119,668 | 181,230 | 3,666,629 | 80,403 | 1,599,666 |
| Fuller's earth, do | 230,814 | 2,264,978 | 226,165 | 2,296,094 | 170,852 | 1,707,869 |
| Garnet for abrasive purposes, do | 3,820 | 315,913 | 4,863 | 382,535 | 2,669 | 191,658 |
| Gems and precious stones | | [18] | | [18] | | [18] |
| Graphite: | | | | | | |
| Amorphous, short tons | [17] | [17] | [17] | [17] | [17] | [17] |
| Crystalline, pounds | [17] | [17] | [17] | [17] | [17] | [17] |
| Grindstones and pulpstones, short tons | 13,175 | 497,997 | 14,541 | 572,708 | 6,206 | 240,006 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Gypsum | do | [19] 2,712,510 | [19] 26,222,377 | [20] 3,058,166 | [20] 4,782,503 | [20] 2,684,205 | [20] 4,271,674 |
| Helium | cubic feet | ([21]) | ([21]) | ([21]) | ([21]) | ([21]) | ([21]) |
| Iodine | pounds | 233,925 | 212,635 | 299,286 | 242,422 | ([17]) | ([17]) |
| Kyanite | short tons | ([5]) | ([5]) | ([5]) | ([5]) | ([5]) | ([5]) |
| Lime | do | 3,749,383 | 26,933,719 | 4,124,165 | 30,091,168 | 3,346,954 | 24,137,638 |
| Lithium minerals | do | 1,241 | 34,273 | 1,357 | 36,206 | 892 | 329,088 |
| Magnesite (crude) | do | 207,119 | 1,411,664 | 203,437 | 1,483,492 | 97,000 | 725,000 |
| Magnesium oxide (hydrated) (brucite) | do | ([17]) | ([17]) | ([17]) | ([17]) | } 141,465,613 | 1,688,570 |
| Magnesium salts (natural) | pounds | 127,682,793 | 1,629,725 | 129,553,918 | 1,578,527 | | |
| Marl: | | | | | | | |
| Calcareous | short tons | 45,528 | 58,682 | 46,650 | 59,775 | 23,572 | 40,270 |
| Greensand | do | 8,368 | 177,835 | 9,734 | 210,974 | 6,576 | 152,000 |
| Mica: | | | | | | | |
| Scrap | do | 20,955 | 260,594 | 25,196 | 354,737 | 20,257 | 256,382 |
| Sheet | pounds | 1,319,233 | 203,879 | 1,694,538 | 285,244 | 939,507 | 139,333 |
| Millstones | | | 10,609 | | 8,305 | | 3,743 |
| Mineral paints: | | | | | | | |
| Cadmium compounds [22] | pounds | ([5]) | 906,000 | ([5]) | 1,441,000 | ([5]) | 710,000 |
| Natural pigments [23] | short tons | ([23]) | ([23]) | ([23]) | ([23]) | ([23]) | ([23]) |
| Zinc and lead pigments [24] | do | 175,734 | 15,850,829 | 163,617 | 17,088,595 | 123,146 | 13,969,840 |
| Mineral waters | gallons sold | ([18]) | ([18]) | ([18]) | ([18]) | ([18]) | ([18]) |
| Natural gas | M cubic feet | 2,167,802,000 | 476,813,000 | 2,407,620,000 | 528,354,000 | 2,263,000,000 | 500,870,000 |
| Natural gasoline | gallons | 1,796,340,000 | 84,572,000 | 2,065,434,000 | 97,125,000 | 2,113,314,000 | 78,195,000 |
| Oilstones, etc | short tons | 752 | 121,196 | 810 | 112,841 | 511 | 130,277 |
| Olivine | do | ([5]) | ([5]) | ([5]) | ([5]) | ([5]) | ([5]) |
| Peat | do | 46,126 | 266,883 | 51,223 | 305,156 | 45,933 | 286,127 |
| Petroleum | barrels (42 gallons) | 1,099,687,000 | 1,199,820,000 | 1,279,160,000 | 1,513,340,000 | 1,213,254,000 | 1,390,000,000 |
| Phosphate rock | long tons | 3,351,857 | 11,406,132 | 3,956,189 | 12,975,268 | 3,739,238 | 12,952,143 |
| Potassium salts | short tons | [25] 222,810 | 6,969,190 | [25] 266,938 | 9,019,534 | [25] 286,437 | 9,748,290 |
| Pumice | do | 72,915 | 328,406 | 71,007 | 301,936 | 65,742 | 312,886 |
| Pyrites | long tons | 547,236 | 1,666,194 | 584,166 | 1,777,787 | 555,629 | 1,685,766 |
| Salt (sodium chloride) | short tons | 8,828,936 | 23,306,177 | 9,241,564 | 24,131,733 | 8,025,768 | 23,242,561 |
| Sand and gravel: | | | | | | | |
| Glass sand | do | 2,394,710 | 4,050,749 | 2,799,230 | 4,746,629 | 2,109,462 | 3,601,734 |
| Sand (molding, building, etc.) and gravel | do | 175,935,104 | 86,257,003 | 186,861,193 | 92,726,368 | 179,210,771 | 82,321,113 |
| Sand-lime brick [13] | thousands | 103,189 | 922,662 | 135,005 | 1,190,773 | ([13]) | ([13]) |
| Silica (quartz) | short tons | 12,986 | 96,592 | 13,012 | 66,041 | 18,611 | 88,197 |
| Slate | do | 454,760 | 5,485,208 | 444,560 | 5,605,322 | 492,690 | 5,655,313 |
| Sodium salts (carbonates and sulfates) (natural) | do | 154,474 | 1,442,923 | 184,764 | 1,790,751 | 180,220 | 1,832,140 |
| Stone [26] | do | 131,416,420 | 141,525,979 | 133,143,240 | 146,213,128 | 124,838,940 | 139,255,046 |
| Sulfur | long tons | 1,968,820 | 35,400,000 | 2,466,512 | 44,300,000 | 1,628,847 | 27,300,000 |
| Sulfuric acid (60° Baumé) (byproduct) [27] | short tons | 732,620 | 5,741,143 | 833,994 | 6,735,194 | ([28]) | ([28]) |
| Talc, pyrophyllite, and ground soapstone [26] | do | 216,191 | 2,343,171 | 229,999 | 2,561,753 | 212,775 | 2,302,560 |
| Tripoli | do | 28,487 | 391,878 | 34,936 | 450,570 | 22,188 | 329,081 |
| Vermiculite | do | 16,933 | 185,787 | 26,556 | 260,664 | 20,700 | 192,000 |
| Other nonmetallic [29] | | | 2,802,781 | | 2,647,381 | | 1,848,890 |
| Total value of nonmetallic products (approximate) | | | 3,475,200,000 | | 3,945,400,000 | | 3,462,200,000 |

See footnotes at end of table.

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*Mineral products of the United States, 1936–38*—Continued

| Product | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value |
| SUMMARY | | | | | | |
| Total value: | | | | | | |
| Metallic | | $1,081,600,000 | | $1,468,200,000 | | $891,800,000 |
| Nonmetallic: | | | | | | |
| Fuels | | 2,759,200,000 | | 3,200,500,000 | | 2,804,700,000 |
| Other | | 716,000,000 | | 744,900,000 | | 657,500,000 |
| Grand total approximate value of mineral products | | 4,556,800,000 | | 5,413,600,000 | | 4,354,000,000 |

[1] In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1938 are subject to revision. For details see following chapters of this volume.

[2] Figures represent antimonial lead produced at primary refineries from both domestic and foreign primary and secondary sources; no figures for value of antimonial lead available. Estimate of value of primary antimony and lead contents of antimonial lead from domestic sources included in total value of metallic products.

[3] Largely from foreign ore; Bureau of Mines not at liberty to publish figures.

[4] Value not included in total value.

[5] Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.

[6] Product from domestic ores only.

[7] According to Bureau of the Mint. Valued at $35 per ounce.

[8] Figures not available.

[9] Figures showing values not available.

[10] Figures for 1938 not yet available.

[11] According to Bureau of the Mint.

[12] Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.

1936: Bismuth, iron ore sold for magnets (5 long tons), and iron ore sold for paint (10,348 long tons, valued at $53,037).

1937: Bismuth, iron ore sold for magnets (2 long tons), and iron ore sold for paint (8,375 long tons, $48,005).

1938: Bismuth, iron ore sold for magnets (2 long tons), and iron ore sold for paint (9,694 long tons, $44,249).

[13] Figures obtained through cooperation with Bureau of the Census. Figures for 1938 not yet available; estimate of value included in total value of nonmetallic products.

[14] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

[15] According to National Bituminous Coal Commission.

[16] Value is estimated from various sources and includes selling expenses.

[17] Value included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.

[18] No canvass. Estimate of value included in total value of nonmetallic products.

[19] Gypsum mined; value as sold (crude and calcined). Comparable value for later years not available.

[20] Gypsum mined; value of crude at mine as reported by producers. Comparable value for years prior to 1937 not available.

[21] Value included in total value of nonmetallic products. For details of production in fiscal years see chapters on Helium.

[22] Largely for use in manufacture of pigments. Figures for quantity of pigment not available.

[23] Canvass discontinued after 1915. Figures for iron ore sold for paint given in footnote 12.

[24] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

[25] Equivalent as $K_2O$.

[26] Figures for soapstone used as dimension stone included in figures for stone.

[27] From copper and zinc smelters and zinc roasters and from roasting of high-sulfide gold and silver concentrates.

[28] Figures not yet available; estimate of value included in total value of nonmetallic products.

[29] Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.

1936: Chats (3,919,300 short tons, valued at $666,000), flint lining for tube mills, pebbles for grinding, silica sand and sandstone (finely ground) (354,505 short tons, $2,121,785), and sulfur ore (13 long tons).

1937: Natural sulfonated bitumen, chats (5,976,040 short tons, $624,111), flint lining for tube mills, optical fluorspar (50 pounds, $120), pebbles for grinding, silica sand and sandstone (finely ground) (328,156 short tons, $1,996,528), and sulfur ore (221 long tons, $2,296).

1938: Natural sulfonated bitumen, chats (2,836,700 short tons, $414,300), flint lining for tube mills, optical fluorspar (5 ounces, $5), pebbles for grinding, and silica sand and sandstone (finely ground) (237,167 short tons, $1,425,445).

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*Value of mineral products of the United States, 1880–1938* [1]

[See second and third paragraphs of this chapter]

| Year | Metallic | Nonmetallic | | | Grand total |
|---|---|---|---|---|---|
| | | Fuels [2] | Other | Total | |
| 1880 [1] | $190,881,000 | $120,241,000 | $56,341,000 | $176,582,000 | $367,463,000 |
| 1881 | 192,663,000 | 149,798,000 | 60,659,000 | 210,457,000 | 403,120,000 |
| 1882 | 219,070,000 | 170,479,000 | 63,557,000 | 234,036,000 | 453,106,000 |
| 1883 | 201,131,000 | 185,760,000 | 61,170,000 | 246,930,000 | 448,061,000 |
| 1884 | 182,784,000 | 165,825,000 | 58,431,000 | 224,256,000 | 407,040,000 |
| 1885 | 174,718,000 | 183,075,000 | 61,758,000 | 244,833,000 | 419,551,000 |
| 1886 | 204,795,000 | 184,608,000 | 66,782,000 | 251,390,000 | 456,185,000 |
| 1887 | 241,183,000 | 217,251,000 | 77,199,000 | 294,450,000 | 535,633,000 |
| 1888 | 242,460,000 | 231,459,000 | 79,880,000 | 311,339,000 | 553,799,000 |
| 1889 | 250,823,000 | 208,297,000 | 83,206,000 | 291,503,000 | 542,326,000 |
| 1890 | 303,937,000 | 230,962,000 | 80,530,000 | 311,492,000 | 615,429,000 |
| 1891 | 280,985,000 | 237,160,000 | 82,704,000 | 319,864,000 | 600,849,000 |
| 1892 | 284,215,000 | 248,344,000 | 89,673,000 | 338,017,000 | 622,232,000 |
| 1893 | 223,654,000 | 251,735,000 | 70,104,000 | 321,839,000 | 545,493,000 |
| 1894 | 187,335,000 | 235,618,000 | 127,292,000 | 362,910,000 | 550,245,000 |
| 1895 | 248,533,000 | 268,438,000 | 125,720,000 | 394,158,000 | 642,691,000 |
| 1896 | 252,575,000 | 268,161,000 | 120,305,000 | 388,466,000 | 641,041,000 |
| 1897 | 270,434,000 | 253,598,000 | 127,580,000 | 381,178,000 | 651,612,000 |
| 1898 | 308,747,000 | 267,513,000 | 150,782,000 | 418,295,000 | 727,042,000 |
| 1899 | 484,021,000 | 340,773,000 | 185,302,000 | 526,075,000 | 1,010,096,000 |
| 1900 | 514,232,000 | 406,376,000 | 188,328,000 | 594,704,000 | 1,108,936,000 |
| 1901 | 493,814,000 | 442,409,000 | 218,855,000 | 661,264,000 | 1,155,078,000 |
| 1902 | 605,017,000 | 469,079,000 | 253,855,000 | 722,934,000 | 1,327,951,000 |
| 1903 | 589,253,000 | 634,226,000 | 271,902,000 | 906,128,000 | 1,495,381,000 |
| 1904 | 501,314,000 | 584,043,000 | 273,824,000 | 857,867,000 | 1,359,181,000 |
| 1905 | 702,785,000 | 602,258,000 | 318,722,000 | 920,980,000 | 1,623,765,000 |
| 1906 | 886,280,000 | 652,398,000 | 362,202,000 | 1,014,600,000 | 1,900,880,000 |
| 1907 | 904,151,000 | 789,128,000 | 376,291,000 | 1,165,419,000 | 2,069,570,000 |
| 1908 | 550,890,000 | 716,034,000 | 324,849,000 | 1,040,883,000 | 1,591,773,000 |
| 1909 | 755,092,000 | 746,204,000 | 385,811,000 | 1,132,015,000 | 1,887,107,000 |
| 1910 | 750,027,000 | 828,213,000 | 409,604,000 | 1,237,817,000 | 1,987,844,000 |
| 1911 | 681,023,000 | 835,763,000 | 407,295,000 | 1,243,058,000 | 1,924,081,000 |
| 1912 | 862,191,000 | 945,541,000 | 430,062,000 | 1,375,603,000 | 2,237,794,000 |
| 1913 | 879,058,000 | 1,087,843,000 | 466,644,000 | 1,554,487,000 | 2,433,545,000 |
| 1914 | 687,101,000 | 992,837,000 | 431,234,000 | 1,424,071,000 | 2,111,172,000 |
| 1915 | 993,353,000 | 972,617,000 | 428,674,000 | 1,401,291,000 | 2,394,644,000 |
| 1916 | 1,622,129,000 | 1,332,584,000 | 553,726,000 | 1,886,310,000 | 3,508,439,000 |
| 1917 | 2,088,914,000 | 2,237,837,000 | 665,745,000 | 2,903,582,000 | 4,992,496,000 |
| 1918 | 2,156,588,000 | 2,736,151,000 | 647,969,000 | 3,384,120,000 | 5,540,708,000 |
| 1919 | 1,361,099,000 | 2,510,894,000 | 751,777,000 | 3,262,671,000 | 4,623,770,000 |
| 1920 | 1,763,675,000 | 4,192,910,000 | 1,024,755,000 | 5,217,665,000 | 6,981,340,000 |
| 1921 | 654,700,000 | 2,703,470,000 | 780,330,000 | 3,483,800,000 | 4,138,500,000 |
| 1922 | 988,100,000 | 2,737,880,000 | 921,310,000 | 3,659,190,000 | 4,647,290,000 |
| 1923 | 1,511,930,000 | 3,317,100,000 | 1,157,470,000 | 4,474,570,000 | 5,986,500,000 |
| 1924 | 1,233,370,000 | 2,898,630,000 | 1,173,800,000 | 4,072,430,000 | 5,305,800,000 |
| 1925 | 1,382,155,000 | 3,058,680,000 | 1,236,795,000 | 4,295,475,000 | 5,677,630,000 |
| 1926 | 1,405,345,000 | 3,541,916,000 | 1,266,339,000 | 4,808,255,000 | 6,213,600,000 |
| 1927 | 1,220,633,000 | 3,060,047,000 | 1,249,320,000 | 4,309,367,000 | 5,530,000,000 |
| 1928 | 1,283,290,000 | 2,884,962,000 | 1,211,948,000 | 4,096,910,000 | 5,385,200,000 |
| 1929 | 1,480,390,000 | 3,190,527,000 | 1,216,683,000 | 4,407,210,000 | 5,887,600,000 |
| 1930 | 985,790,000 | 2,764,500,000 | 1,014,510,000 | 3,779,010,000 | 4,764,800,000 |
| 1931 | 569,790,000 | 1,892,400,000 | 704,410,000 | 2,596,810,000 | 3,166,600,000 |
| 1932 | 285,875,000 | 1,743,400,000 | 432,425,000 | 2,175,825,000 | 2,461,700,000 |
| 1933 | 417,065,000 | 1,683,400,000 | 454,635,000 | 2,138,035,000 | 2,555,100,000 |
| 1934 | 548,934,000 | 2,233,300,000 | 543,166,000 | 2,776,466,000 | 3,325,400,000 |
| 1935 | 733,130,000 | 2,330,000,000 | 586,870,000 | 2,916,870,000 | 3,650,000,000 |
| 1936 | 1,081,600,000 | 2,759,200,000 | 716,000,000 | 3,475,200,000 | 4,556,800,000 |
| 1937 | 1,468,200,000 | 3,200,500,000 | 744,900,000 | 3,945,400,000 | 5,413,600,000 |
| 1938 [3] | 891,800,000 | 2,804,700,000 | 657,500,000 | 3,462,200,000 | 4,354,000,000 |
| Grand total | 43,440,027,000 | 77,939,052,000 | 27,089,510,000 | 105,028,562,000 | 148,468,589,000 |

[1] Figures for earlier years not available.
[2] Coal, natural gas, natural gasoline, petroleum.
[3] Subject to revision.



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The sum of the following State totals does not reach the total for the United States given in the preceding table partly because figures for certain of the products included in the United States total are not available by States of origin. This fact is brought out in the opening text of this chapter and in the second table following.

In addition, there are many factors (the more important discussed in the opening text) that account for the disagreement between the sum of the State totals and the grand total for the United States, by products. Chief among these are: (1) The use of iron ore values in State totals and pig iron values in United States total; (2) the use of mine figures for gold, silver, copper, lead, and zinc in the State totals and mint and smelter figures (supplemented by the value of byproduct sulfuric acid from copper and zinc smelting and zinc roasting and the value of zinc and lead pigments made in large part direct from ores) in the United States total; and (3) the inclusion of estimates in the United States total for a few products for which no canvass has been conducted for many years and for which no estimate by States is made.

Many other less important differences are involved, but both State and United States totals are as complete and definite as seems possible with the data available. The practice is consistent from year to year, and it is believed that the reader can determine readily just what minerals are covered by the total concerned.

In every table each mineral produced is listed, and all figures are shown except those that the Bureau of Mines is not at liberty to publish.

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*Value of mineral products of the United States, 1933–37, by States*

[See second and third paragraphs of this chapter]

| State | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Alabama | $23, 291, 204 | $29, 827, 048 | $31, 772, 042 | $44, 752, 688 | $53, 518, 993 |
| Alaska | 12, 681, 071 | 19, 578, 971 | 18, 811, 544 | 23, 737, 714 | 27, 927, 958 |
| Arizona | 12, 570, 753 | 26, 062, 865 | 38, 848, 203 | 60, 532, 996 | 94, 564, 494 |
| Arkansas | 12, 710, 203 | 16, 081, 642 | 17, 608, 569 | 21, 296, 783 | 25, 578, 393 |
| California | 293, 034, 859 | 331, 255, 652 | 360, 178, 680 | 437, 565, 809 | 476, 974, 925 |
| Colorado | 27, 259, 095 | 39, 473, 123 | 44, 413, 477 | 56, 214, 827 | 67, 338, 548 |
| Connecticut | 1, 550, 594 | 2, 276, 061 | 2, 656, 207 | 3, 317, 494 | 3, 689, 554 |
| Delaware | 135, 397 | 271, 814 | 229, 904 | 444, 093 | 397, 362 |
| District of Columbia | 423, 233 | 406, 891 | 479, 256 | 547, 576 | 522, 687 |
| Florida | 8, 843, 896 | 11, 548, 144 | 11, 447, 052 | 12, 973, 243 | 13, 811, 958 |
| Georgia | 7, 529, 321 | 7, 986, 388 | 9, 803, 955 | 11, 756, 592 | 12, 584, 060 |
| Idaho | 12, 429, 155 | 16, 708, 153 | 21, 364, 029 | 29, 965, 964 | 40, 633, 119 |
| Illinois | 74, 837, 452 | 89, 213, 596 | 96, 483, 558 | 117, 916, 128 | 133, 437, 554 |
| Indiana | 34, 010, 753 | 39, 416, 727 | 42, 512, 613 | 52, 281, 539 | 54, 886, 756 |
| Iowa | 15, 154, 652 | 19, 326, 181 | 21, 709, 817 | 28, 359, 140 | 26, 941, 350 |
| Kansas | 57, 974, 881 | 81, 117, 503 | 96, 905, 947 | 121, 689, 562 | 154, 376, 403 |
| Kentucky | 65, 536, 454 | 89, 042, 117 | 98, 486, 090 | 113, 435, 307 | 127, 423, 680 |
| Louisiana | 54, 886, 010 | 85, 210, 783 | 107, 544, 710 | 153, 358, 397 | 182, 118, 905 |
| Maine | 2, 593, 871 | 2, 352, 076 | 2, 559, 648 | 3, 423, 353 | 4, 129, 391 |
| Maryland | 7, 014, 570 | 10, 128, 349 | 10, 035, 751 | 11, 157, 550 | 10, 634, 854 |
| Massachusetts | 4, 917, 110 | 6, 165, 303 | 5, 650, 148 | 7, 559, 253 | 7, 813, 345 |
| Michigan | 54, 222, 848 | 61, 831, 364 | 77, 149, 256 | 100, 646, 492 | 119, 167, 573 |
| Minnesota | 42, 472, 038 | 48, 328, 235 | 57, 313, 256 | 94, 568, 991 | 152, 107, 070 |
| Mississippi | 2, 765, 988 | 2, 520, 521 | 3, 092, 609 | 3, 846, 104 | 4, 821, 950 |
| Missouri | 30, 588, 018 | 32, 954, 534 | 35, 800, 213 | 41, 350, 860 | 52, 446, 272 |
| Montana | 21, 662, 089 | 31, 430, 496 | 52, 096, 553 | 65, 569, 150 | 82, 086, 815 |
| Nebraska | 2, 047, 335 | 2, 790, 571 | 3, 228, 856 | 3, 843, 562 | 4, 837, 809 |
| Nevada | 7, 455, 493 | 14, 702, 869 | 20, 987, 749 | 32, 693, 129 | 38, 871, 816 |
| New Hampshire | 1, 457, 041 | 1, 149, 289 | 693, 988 | 1, 182, 055 | 1, 219, 869 |
| New Jersey | 22, 580, 043 | 25, 009, 596 | 28, 514, 673 | 24, 421, 046 | 31, 467, 931 |
| New Mexico | 23, 354, 681 | 30, 079, 469 | 33, 502, 362 | 45, 942, 006 | 72, 855, 745 |
| New York | 42, 940, 471 | 54, 625, 552 | 58, 408, 999 | 71, 647, 775 | 77, 665, 874 |
| North Carolina | 3, 365, 160 | 5, 342, 306 | 6, 774, 649 | 9, 955, 519 | 11, 160, 444 |
| North Dakota | 2, 960, 811 | 2, 549, 850 | 2, 543, 910 | 2, 902, 453 | 2, 873, 011 |
| Ohio | 91, 145, 609 | 117, 504, 662 | 126, 133, 670 | 122, 684, 043 | 131, 025, 104 |
| Oklahoma | 172, 560, 924 | 237, 208, 583 | 251, 700, 898 | 305, 191, 649 | 367, 444, 222 |
| Oregon | 3, 504, 825 | 4, 211, 397 | 5, 596, 484 | 7, 080, 975 | 6, 609, 710 |
| Pennsylvania | 421, 846, 539 | 546, 932, 552 | 520, 575, 611 | 599, 457, 486 | 599, 817, 364 |
| Rhode Island | 386, 983 | 485, 441 | 570, 520 | 929, 103 | 862, 710 |
| South Carolina | 1, 014, 162 | 1, 323, 293 | 1, 843, 476 | 3, 432, 662 | 4, 022, 325 |
| South Dakota | 14, 658, 504 | 19, 173, 033 | 22, 209, 554 | 23, 221, 620 | 23, 472, 873 |
| Tennessee | 16, 785, 481 | 23, 525, 650 | 25, 743, 471 | 31, 121, 865 | 34, 893, 847 |
| Texas | 365, 571, 179 | 509, 521, 286 | 528, 069, 238 | 638, 643, 488 | 813, 270, 605 |
| Utah | 24, 179, 771 | 32, 527, 119 | 41, 933, 136 | 61, 209, 302 | 105, 652, 422 |
| Vermont | 5, 792, 574 | 4, 852, 949 | 5, 097, 295 | 6, 225, 396 | 7, 042, 547 |
| Virginia | 18, 845, 740 | 28, 309, 377 | 30, 923, 115 | 37, 295, 168 | 46, 019, 085 |
| Washington | 9, 387, 645 | 12, 944, 751 | 13, 688, 083 | 22, 921, 456 | 26, 658, 257 |
| West Virginia | 172, 726, 695 | 241, 473, 621 | 245, 402, 124 | 271, 501, 941 | 306, 660, 947 |
| Wisconsin | 7, 153, 881 | 9, 752, 431 | 11, 817, 933 | 13, 277, 983 | 15, 228, 024 |
| Wyoming | 22, 025, 393 | 27, 640, 294 | 30, 669, 658 | 34, 498, 261 | 41, 087, 908 |

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*Mineral products of the United States and principal producing States in 1937*

[See second and third paragraphs of this chapter]

| Rank in value | Product | Principal producing States [1] | |
|---|---|---|---|
| | | In order of quantity | In order of value |
| 17 | Aluminum | New York, Tennessee, North Carolina | Rank same as for quantity. |
| (2) | Antimonial lead | Not separable by States | Not separable by States. |
| 76 | Antimony ore | Idaho, Alaska, Nevada, Washington | Alaska, Idaho, Nevada, California. |
| 62 | Arsenious oxide | Montana, Utah, Idaho | Rank same as for quantity. |
| 67 | Asbestos | Vermont, Arizona, Maryland, North Carolina | Do. |
| | Asphalt: | | |
| 38 | Native | Oklahoma, Kentucky, Texas, Alabama | Utah, Kentucky, Oklahoma, Texas. |
| 20 | Oil | Not separable by States | Not separable by States. |
| 42 | Barite (crude) | Missouri, Georgia, Tennessee, California | Rank same as for quantity. |
| 40 | Bauxite | Arkansas, Alabama, Georgia | Do. |
| 57 | Bismuth | Not separable by States | Not separable by States. |
| 90 | Bitumen (natural sulfonated) | Utah | Rank same as for quantity. |
| 29 | Borates | California | Do. |
| 32 | Bromine | Michigan, North Carolina, West Virginia, California | Do. |
| 34 | Cadmium | Not separable by States | Not separable by States. |
| 50 | Cadmium compounds | do | Do. |
| 52 | Calcium-magnesium chloride | Michigan, West Virginia, Ohio | Rank same as for quantity. |
| 8 | Cement | Pennsylvania, California, Michigan, Texas | Pennsylvania, California, Texas, Michigan. |
| 59 | Chats | Oklahoma, Missouri, Kansas | Rank same as for quantity. |
| 86 | Chromite | California, Oregon | Do. |
| | Clay: | | |
| 11 | Products (other than pottery and refractories) | | Ohio, Pennsylvania, California, Illinois. |
| 25 | Raw (sold by producers) | Pennsylvania, Missouri, Georgia, Ohio | Georgia, Pennsylvania, Missouri, Kentucky. |
| 2 | Coal: | | |
| | Bituminous | West Virginia, Pennsylvania, Illinois, Kentucky | Pennsylvania, West Virginia, Illinois, Kentucky. |
| | Pennsylvania anthracite | Pennsylvania | Rank same as for quantity. |
| 5 | Coke | Pennsylvania, Ohio, Indiana, New York | Pennsylvania, Indiana, Ohio, New York. |
| 7 | Copper | Arizona, Utah, Montana, Nevada | Rank same as for quantity. |
| 46 | Diatomite | California, Oregon, Washington, New Jersey | Do. |
| 92 | Emery | New York | Do. |
| 51 | Feldspar (crude) | North Carolina, Colorado, South Dakota, New Hampshire | Do. |
| 14 | Ferro-alloys | Pennsylvania, New York, Ohio, West Virginia | Pennsylvania, New York, West Virginia, Ohio. |
| 85 | Flint lining for tube mills | Minnesota | Rank same as for quantity. |
| 37 | Fluorspar | Kentucky, Illinois, Colorado, New Mexico | Illinois, Kentucky, Colorado, New Mexico. |
| 41 | Fuller's earth | Georgia, Florida, Texas, Illinois | Rank same as for quantity. |
| 65 | Garnet (abrasive) | New York, New Hampshire, North Carolina | Do. |
| (3) | Gems and precious stones | No canvass for 1937 | No canvass for 1937. |
| 9 | Gold | California, Alaska, South Dakota, Colorado | Rank same as for quantity. |

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| | | | |
|---|---|---|---|
| 88 | Graphite: | | |
| | Amorphous | Nevada, Michigan | Do. |
| | Crystalline | Texas, Montana | Montana, Texas. |
| 61 | Grindstones and pulpstones | Ohio, West Virginia, Washington | Rank same as for quantity. |
| 33 | Gypsum (crude) | New York, Michigan, Iowa, Texas | New York, Michigan, Iowa, Virginia. |
| 80 | Helium | Texas | Rank same as for quantity. |
| 72 | Iodine (natural) | California | Do. |
| | Iron: | | |
| 6 | Ore | Minnesota, Michigan, Alabama, Pennsylvania | Minnesota, Michigan, Alabama, Wisconsin. |
| 3 | Pig | Pennsylvania, Ohio, Indiana, Illinois | Rank same as for quantity. |
| 56 | Sinter | Tennessee | Do. |
| (4) | Kyanite | No figures available | No figures available. |
| 18 | Lead | Missouri, Idaho, Utah, Oklahoma | Rank same as for quantity. |
| 21 | Lime | Ohio, Pennsylvania, Missouri, West Virginia | Do. |
| 82 | Lithium minerals | South Dakota | Do. |
| 49 | Magnesite (crude) | Washington, California | Do. |
| 55 | Magnesium | Michigan | Do. |
| 84 | Magnesium hydrate (brucite) | Nevada | Do. |
| 47 | Magnesium salts (natural) | Michigan, California, Washington, West Virginia | Do. |
| 54 | Manganese ore | Montana, Arkansas, Tennessee, Virginia | Montana, Tennessee, Arkansas, Virginia. |
| 36 | Manganiferous ore | Minnesota, Montana, New Mexico, Colorado | Rank same as for quantity. |
| 71 | Manganiferous zinc residuum | New Jersey | Do. |
| | Marl: | | |
| 79 | Calcareous | West Virginia, Wisconsin, Virginia, North Carolina | West Virginia, North Carolina, Virginia, Nevada. |
| 73 | Greensand | New Jersey | Rank same as for quantity. |
| 48 | Mercury | California, Oregon, Texas, Arkansas | Do. |
| 58 | Mica | North Carolina, Georgia, California, Virginia | North Carolina, Georgia, Connecticut, Virginia. |
| | Scrap | do | North Carolina, Georgia, Virginia, California. |
| | Sheet | North Carolina, Connecticut, New Hampshire, Virginia | North Carolina, Connecticut, New Hampshire, New Mexico. |
| 89 | Millstones | | New York, Virginia. |
| 24 | Mineral paints (zinc and lead pigments) | Pennsylvania, Kansas, Illinois, Ohio | Rank same as for quantity. |
| (3) | Mineral waters | No canvass for 1937 | No canvass for 1937. |
| 23 | Molybdenum | Colorado, Utah, Arizona, New Mexico | Rank same as for quantity. |
| 4 | Natural gas | Texas, California, Louisiana, Oklahoma | Texas, California, West Virginia, Louisiana. |
| 13 | Natural gasoline | California, Texas, Oklahoma, Louisiana | Rank same as for quantity. |
| 75 | Nickel | Not separable by States | Not separable by States. |
| 77 | Oilstones, etc | New Hampshire, Ohio, Indiana, Arkansas | Arkansas, Ohio, Indiana, New Hampshire. |
| (4) | Olivine | No figures available | No figures available. |
| (5) | Ores (crude), etc.: | | |
| | Copper | Utah, Arizona, Nevada, Michigan | Value not available. |
| | Dry and siliceous (gold and silver) | Alaska, California, Nevada, Colorado | Do. |
| | Lead | Missouri, Idaho, Utah, Colorado | Do. |
| | Lead-copper | Nevada, Colorado, New Mexico, Arizona | Do. |
| | Zinc | Oklahoma, Kansas, Tennessee, New Jersey | Do. |
| | Zinc-lead | Oklahoma, Kansas, Idaho, Utah | Do. |
| 68 | Peat | New Jersey, New York, Florida, Michigan | Florida, New Jersey, Michigan, Ohio. |

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
[2] Separate figures for antimonial lead from primary sources not available.
[3] No canvass for 1937.
[4] No figures available.
[5] Value not available.

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*Mineral products of the United States and principal producing States in 1937*—Continued

| Rank in value | Product | Principal producing States | |
|---|---|---|---|
| | | In order of quantity | In order of value |
| 91 | Pebbles for grinding | Minnesota | Rank same as for quantity. |
| 1 | Petroleum | Texas, California, Oklahoma, Louisiana | Texas, Oklahoma, California, Louisiana. |
| 26 | Phosphate rock | Florida, Tennessee, Idaho, Montana | Rank same as for quantity. |
| 43 | Platinum and allied metals | Alaska, California, Oregon | Do. |
| 28 | Potassium salts | New Mexico, California, Maryland, Utah | Do. |
| 69 | Pumice | Kansas, California, Nebraska, Oklahoma | California, Kansas, Nebraska, Oklahoma. |
| 45 | Pyrites | Tennessee, Virginia, New York, California | Rank same as for quantity. |
| 22 | Salt | Michigan, New York, Ohio, Louisiana | Michigan, New York, Louisiana, Kansas. |
| 12 | Sand and gravel | Illinois, California, New York, Michigan | Pennsylvania, Illinois, Washington, California. |
| 53 | Sand-lime brick | New York, Massachusetts, Minnesota, Michigan | New York, Massachusetts, Michigan, Minnesota. |
| 63 | Selenium | Not separable by States | Not separable by States. |
| 78 | Silica (quartz) | Ohio, Tennessee, North Carolina, California | Rank same as for quantity. |
| 44 | Silica sand and sandstone (finely ground). | Illinois, New Jersey, Pennsylvania, Ohio | Illinois, New Jersey, Ohio, West Virginia. |
| 16 | Silver | Idaho, Utah, Montana, Arizona | Rank same as for quantity. |
| 31 | Slate | | Pennsylvania, Vermont, Maine, New York. |
| 27 | Sodium salts (other than NaCl) (natural). | California, Texas, Wyoming | Rank same as for quantity. |
| 10 | Stone | Pennsylvania, Michigan, New York, Ohio | Pennsylvania, New York, Ohio, Illinois. |
| 19 | Sulfur | Texas, Louisiana, California, Utah | Rank same as for quantity. |
| 30 | Sulfuric acid from copper and zinc smelters and roasters and from roasting of high-sulfide gold and silver concentrates. | Pennsylvania, Tennessee, Illinois, Arizona | Pennsylvania, Illinois, Tennessee, Arizona. |
| 93 | Sulfur ore | Nevada, Colorado | Rank same as for quantity. |
| 39 | Talc and ground soapstone[6] | New York, Vermont, California, North Carolina | New York, California, Vermont, North Carolina. |
| 87 | Tantalum ore | South Dakota, North Carolina, New Mexico, Colorado | Rank same as for quantity. |
| 83 | Tellurium | Not separable by States | Not separable by States. |
| 74 | Tin | Alaska, Wyoming, South Dakota, South Carolina | Rank same as for quantity. |
| | Titanium ore: | | |
| 81 | Ilmenite | Virginia | Do. |
| 66 | Rutile | Virginia, Arkansas | Do. |
| 64 | Tripoli | Missouri, Illinois, Oklahoma, Arkansas | Do. |
| 35 | Tungsten ore | Nevada, California, Arizona, Colorado | Do. |
| 60 | Uranium and vanadium ores | Arizona, Colorado, Utah | Colorado, Arizona, Utah. |
| 70 | Vermiculite | Montana, Colorado, Wyoming | Rank same as for quantity. |
| 15 | Zinc | Oklahoma, New Jersey, Kansas, Idaho | Do. |

[6] Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

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*States and their principal mineral products in 1937* [1]

[See second and third paragraphs of this chapter]

| State | Rank | Principal mineral products in order of value |
|---|---|---|
| Alabama | 20 | Coal, iron ore, cement, clay products. |
| Alaska | 28 | Gold, copper, coal, silver. |
| Arizona | 14 | Copper, gold, silver, lead. |
| Arkansas | 31 | Petroleum, coal, bauxite, natural gas. |
| California | 3 | Petroleum, natural gas, gold, natural gasoline. |
| Colorado | 18 | Coal, molybdenum, gold, silver. |
| Connecticut | 45 | Stone, clay products, sand and gravel, lime. |
| Delaware | 50 | Clay products, stone, sand and gravel, raw clay. |
| District of Columbia | 49 | Clay products, stone. |
| Florida | 34 | Phosphate rock, stone, cement, sand and gravel. |
| Georgia | 35 | Stone, raw clay, clay products, cement. |
| Idaho | 24 | Silver, lead, zinc, gold. |
| Illinois | 9 | Coal, petroleum, stone, sand and gravel. |
| Indiana | 19 | Coal, cement, stone, clay products. |
| Iowa | 29 | Do. |
| Kansas | 7 | Petroleum, natural gas, zinc, coal. |
| Kentucky | 11 | Coal, natural gas, petroleum, stone. |
| Louisiana | 6 | Petroleum, natural gas, sulfur, natural gasoline. |
| Maine | 43 | Stone, sand and gravel, cement, slate. |
| Maryland | 37 | Coal, sand and gravel, cement, clay products. |
| Massachusetts | 38 | Stone, sand and gravel, lime, clay products. |
| Michigan | 12 | Iron ore, petroleum, copper, cement. |
| Minnesota | 8 | Iron ore, manganiferous ore, stone, sand and gravel. |
| Mississippi | 42 | Natural gas, sand and gravel, clay products, raw clay. |
| Missouri | 21 | Lead, coal, cement, stone. |
| Montana | 15 | Copper, silver, petroleum, gold. |
| Nebraska | 41 | Cement, stone, sand and gravel, clay products. |
| Nevada | 25 | Copper, gold, silver, tungsten ore. |
| New Hampshire | 47 | Stone, clay products, sand and gravel, feldspar. |
| New Jersey | 27 | Zinc, clay products, sand and gravel, stone. |
| New Mexico | 17 | Petroleum, copper, natural gas, potassium salts. |
| New York | 16 | Petroleum, natural gas, stone, cement. |
| North Carolina | 36 | Stone, clay products, bromine, sand and gravel. |
| North Dakota | 46 | Coal, sand and gravel, clay products, stone. |
| Ohio | 10 | Coal, clay products, natural gas, stone. |
| Oklahoma | 4 | Petroleum, natural gas, natural gasoline, zinc. |
| Oregon | 40 | Gold, stone, cement, sand and gravel. |
| Pennsylvania | 2 | Coal, petroleum, natural gas, cement. |
| Rhode Island | 48 | Stone, sand and gravel, clay products, lime. |
| South Carolina | 44 | Stone, clay products, raw clay, sand and gravel. |
| South Dakota | 32 | Gold, stone, cement, sand and gravel. |
| Tennessee | 26 | Coal, cement, stone, zinc. |
| Texas | 1 | Petroleum, natural gas, sulfur, natural gasoline. |
| Utah | 13 | Copper, gold, lead, silver. |
| Vermont | 39 | Stone, slate, lime, talc. |
| Virginia | 22 | Coal, stone, zinc, clay products. |
| Washington | 30 | Sand and gravel, coal, cement, stone. |
| West Virginia | 5 | Coal, natural gas, petroleum, stone. |
| Wisconsin | 33 | Iron ore, stone, sand and gravel, cement. |
| Wyoming | 23 | Petroleum, coal, natural gas, natural gasoline. |

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis.

*Prices of gold, silver, copper, lead, and zinc, 1933–38* [1]

| Year | Gold [2] | Silver [3] | Copper [4] | Lead [4] | Zinc [4] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1933 | $25.56 | $0.350 | $0.064 | $0.037 | $0.042 |
| 1934 | 34.95 | [5].646+ | .080 | .037 | .043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [5].646+ | .098 | .046 | .048 |

[1] Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ per fine ounce. For table of prices for silver, copper, lead, and zinc from 1850 to 1931, by years, see Mineral Resources, 1931, pt. 1, p. A115.

[2] 1933–34: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934.

[3] 1933: Average New York price for bar silver; 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[4] Yearly average weighted price of all grades of primary metal sold by producers.

[5] $0.64646464.

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## STATE TABLES

[See second and third paragraphs of this chapter]

*Mineral production of Alabama, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asphalt (native)—short tons | (1) | (1) | (1) | (1) |
| Bauxite—long tons | (1) | (1) | (1) | (1) |
| Cement—barrels | [2] 3,823,246 | [2] $5,597,211 | [2] 4,403,459 | [2] $6,165,974 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [3] 1,818,513 | | [3] 2,077,606 |
| Raw (sold by producers)—short tons | 79,365 | 93,157 | 76,584 | 99,730 |
| Coal—do | [4] 12,229,287 | [4] 26,046,000 | [4] 12,440,322 | [5] 29,857,000 |
| Coke—do | 3,089,622 | [6] 8,774,694 | 4,259,771 | [6] 13,275,098 |
| Copper—pounds | 14,000 | 1,288 | 7,000 | 847 |
| Ferro-alloys—long tons | 27,931 | [6] 1,697,712 | 20,470 | [6] 1,455,967 |
| Gold—troy ounces | 4,726 | 165,410 | 2,460 | 86,096 |
| Iron: | | | | |
| Ore—long tons | 4,259,804 | 6,838,016 | 6,350,316 | 10,747,967 |
| Pig—do | 2,061,534 | [6] 30,942,051 | 2,528,785 | [6] 42,188,993 |
| Lime—short tons | 177,582 | 1,034,110 | 176,085 | 964,400 |
| Manganese ore—long tons | 572 | 9,558 | 289 | 8,448 |
| Manganiferous ore—do | 540 | 5,132 | 428 | 2,884 |
| Mica, sheet—pounds | (1) | (1) | | |
| Mineral waters—gallons sold | (7) | (7) | (7) | (7) |
| Ore (dry and siliceous) (gold and silver)—short tons | 30,829 | (8) | 20,173 | (8) |
| Sand and gravel—do | 1,259,344 | 507,257 | 1,489,131 | 695,858 |
| Silver—troy ounces | 869 | 673 | 457 | 353 |
| Stone—short tons | [9] 1,234,490 | [9] 1,675,428 | [9] 1,500,860 | [9] 1,573,890 |
| Miscellaneous [10] | | 960,935 | | 1,237,940 |
| Total value, eliminating duplications | | 44,752,688 | | 53,518,993 |

[1] Value included under "Miscellaneous."
[2] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to National Bituminous Coal Commission.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value not included in total value for State.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of granite in 1936 and of dimension limestone in 1937, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1", "3", and "9" above.

*Mineral production of Alaska, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Antimony ore (concentrates)—short tons | | | (1) | (1) |
| Arsenic—do | (2) | (2) | (2) | (2) |
| Coal—do | [3] 136,593 | [3] $574,000 | [4] 131,600 | [4] $552,700 |
| Copper—pounds | 37,700,000 | 3,468,400 | 34,672,000 | 4,195,312 |
| Gold—troy ounces | 540,580 | 18,920,300 | 627,940 | 21,977,900 |
| Lead—short tons | 941 | 86,572 | 823 | 97,114 |
| Ores (crude), etc.: | | | | |
| Copper—do | 143,132 | (5) | 139,279 | (5) |
| Dry and siliceous (gold and silver)—do | 4,466,644 | (5) | 4,580,923 | (5) |
| Lead—do | 3 | (5) | | |
| Platinum and allied metals—troy ounces | 2,740 | 130,793 | 5,431 | 313,367 |
| Sand and gravel—short tons | (1) | (1) | (1) | (1) |
| Silver—troy ounces | 484,306 | 375,095 | 494,340 | 382,372 |
| Stone—short tons | 21,970 | 31,747 | [6] 38,450 | [6] 59,845 |
| Tin (metallic equivalent)—do | 113 | 105,000 | 186 | 202,300 |
| Miscellaneous | | 45,807 | | 147,048 |
| Total value, eliminating duplications | | 23,737,714 | | 27,927,958 |

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] According to National Bituminous Coal Commission.
[4] According to the Alaskan Branch of the Geological Survey.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of dimension unclassified stone, value for which is included under "Miscellaneous."

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*Mineral production of Arizona, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asbestos—short tons | 464 | $41,780 | 648 | $76,059 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1] 157,178 | | [1] 209,631 |
| Raw (sold by producers)—short tons | [2] | [2] | [2] | [2] |
| Coal—do | [2 3] | [2 3] | [2 3] | [2 4] |
| Copper—pounds | 422,550,000 | 38,874,600 | 576,956,000 | 69,811,676 |
| Feldspar (crude)—long tons | [2] | [2] | [2] | [2] |
| Fluorspar—short tons | 40 | [2] | 610 | [2] |
| Gems and precious stones | | [5] | | [5] |
| Gold—troy ounces | 322,408 | 11,284,287 | 332,694 | 11,644,290 |
| Gypsum—short tons | [2 6] | [2 6] | [2 7] | [2 7] |
| Lead—do | 10,688 | 983,296 | 12,354 | 1,457,772 |
| Lime—do | 25,922 | 249,560 | 54,789 | 466,098 |
| Mercury—flasks (76 pounds) | [2] | [2] | 37 | 3,337 |
| Mica, scrap—short tons | [2] | [2] | [2] | [2] |
| Molybdenum—pounds | 1,461,908 | [2] | 1,173,942 | [2] |
| Ores (crude), etc.: | | | | |
| Copper—short tons | 12,829,873 | [8] | 19,928,824 | [8] |
| Dry and siliceous (gold and silver)—do | 809,341 | [8] | 804,949 | [8] |
| Lead—do | 25,933 | [8] | 29,969 | [8] |
| Lead-copper—do | 228 | [8] | 59 | [8] |
| Zinc—do | | | 91 | [8] |
| Zinc-lead—do | 154,463 | [8] | 212,467 | [8] |
| Sand and gravel—do | 425,289 | 120,258 | 1,266,686 | 632,354 |
| Sand-lime brick—thousands | [1 2] | [1 2] | [1 2] | [1 2] |
| Silica (quartz)—short tons | [2] | [2] | [2] | [2] |
| Silver—troy ounces | 8,386,043 | 6,494,990 | 9,422,552 | 7,288,344 |
| Stone—short tons | [9] 252,140 | [9] 298,943 | 754,170 | 983,073 |
| Sulfuric acid [10]—do | [2 11] | [2 11] | [2 11] | [2 11] |
| Tungsten ore (60-percent concentrates)—do | 489 | 410,934 | 349 | [2] |
| Vanadium ores—do | [2] | [2] | [2] | [2] |
| Zinc—do | 3,589 | 358,900 | 5,026 | 653,380 |
| Miscellaneous [12] | | 1,773,359 | | 1,878,418 |
| Total value, eliminating duplications | | 60,532,996 | | 94,564,494 |

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; valueof crude at mine as reported by producers. Comparable value for earlier years not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] From copper smelting.
[11] Value not included in total value for State.
[12] Includes minerals indicated by "2" and "9" above.

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*Mineral production of Arkansas, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Bauxite long tons | 354,943 | $2,089,196 | 402,195 | $2,322,861 |
| Cement barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] 800,851 | | [2] 729,920 |
| Raw (sold by producers) short tons | (1) | (1) | (1) | (1) |
| Coal do | [3] 1,622,787 | [3] 5,064,000 | [3] 1,510,753 | [4] 5,333,000 |
| Gems and precious stones | | (5) | | (5) |
| Iron ore sold for magnets long tons | 5 | (1) | 2 | (1) |
| Lead short tons | 24 | 2,208 | 40 | 4,720 |
| Lime do | (1) | (1) | (1) | (1) |
| Manganese ore long tons | 4,557 | (1) | 3,931 | (1) |
| Manganiferous ore do | 3,285 | (1) | 7,509 | (1) |
| Mercury flasks (76 pounds) | (1) | (1) | (1) | (1) |
| Mineral waters gallons sold | (5) | (5) | (5) | (5) |
| Natural gas M cubic feet | 8,500,000 | 1,804,000 | 9,690,000 | 1,984,000 |
| Natural gasoline gallons | 11,957,000 | 541,000 | 11,285,000 | 577,000 |
| Oilstones short tons | 119 | 64,817 | 47 | 44,465 |
| Ores (crude), etc.: | | | | |
| Lead do | (6) | (7) | (6) | (7) |
| Zinc do | (6) | (7) | (6) | (7) |
| Petroleum barrels | 10,469,000 | 8,160,000 | 11,764,000 | 11,400,000 |
| Sand and gravel short tons | 1,068,224 | 565,478 | 3,370,634 | 757,162 |
| Slate | | (1) | | (1) |
| Stone short tons | 521,760 | 533,177 | 476,370 | 485,685 |
| Titanium minerals: Rutile do | (1) | (1) | (1) | (1) |
| Tripoli do | (1) | (1) | (1) | (1) |
| Zinc do | 182 | 18,200 | 241 | 31,330 |
| Miscellaneous [8] | | 1,653,856 | | 1,908,250 |
| Total value, eliminating duplications | | 21,296,783 | | 25,578,393 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Figures not available.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Includes minerals indicated by "1" above.

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*Mineral production of California, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Antimony ore—short tons | | | 15 | (1) |
| Asphalt (native)—do | (1) | (1) | (1) | (1) |
| Barite—do | (1) | (1) | (1) | (1) |
| Borates—do | 313,759 | $6,156,123 | 358,898 | $7,232,897 |
| Bromine—pounds | (1) | (1) | (1) | (1) |
| Calcium chloride—short tons | (1) | (1) | | |
| Cement—barrels | 13,225,868 | 19,148,864 | 11,877,642 | 17,900,739 |
| Chromite—long tons | 269 | 2,978 | 2,033 | 14,008 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [3] 6,787,516 | | [3] 8,020,197 |
| Raw (sold by producers)—short tons | 334,513 | 763,559 | 382,224 | 918,974 |
| Coal—do | | | (1 2) | (1 4) |
| Copper—pounds | 8,762,000 | 806,104 | 10,502,000 | 1,270,742 |
| Diatomite—short tons | (1) | (1) | (1) | (1) |
| Feldspar (crude)—long tons | 4,700 | 41,050 | 1,836 | 9,660 |
| Ferro-alloys—do | (1 5) | (1 5) | | |
| Fuller's earth—short tons | 1,311 | 22,069 | (1) | (1) |
| Gems and precious stones | | (6) | | (6) |
| Gold—troy ounces | 1,077,442 | 37,710,470 | 1,174,578 | 41,110,230 |
| Gypsum—short tons | [7] 142,853 | (1 7) | [8] 186,158 | [8] 355,834 |
| Iodine—pounds | 233,925 | 212,635 | 299,286 | 242,422 |
| Iron ore— | | | | |
| Sold to furnaces—long tons | 31,045 | (1) | 97 | 808 |
| Sold for paint—do | (1) | (1) | (1) | (1) |
| Kyanite—short tons | (9) | (9) | (9) | (9) |
| Lead—do | 482 | 44,344 | 1,186 | 139,948 |
| Lime—do | 67,951 | 672,284 | 71,965 | 737,387 |
| Magnesite—do | (1) | (1) | (1) | (1) |
| Magnesium salts (natural)—pounds | (1) | (1) | (1) | (1) |
| Marl, calcareous—short tons | (1) | (1) | (1) | (1) |
| Mercury—flasks (76 pounds) | 8,693 | 694,744 | 9,743 | 878,624 |
| Mica, scrap—short tons | | | (1) | (1) |
| Mineral paints (zinc and lead pigments)—do | (1 5) | (1 5) | (1 5) | (1 5) |
| Mineral waters—gallons sold | (6) | (6) | (6) | (6) |
| Natural gas—M cubic feet | 320,406,000 | 82,401,000 | 329,769,000 | 91,089,000 |
| Natural gasoline—gallons | 593,416,000 | 35,437,000 | 623,894,000 | 37,719,000 |
| Ores (crude), etc.: | | | | |
| Copper—short tons | 453,877 | (10) | 447,248 | (10) |
| Dry and siliceous (gold and silver)—do | 4,179,341 | (10) | 4,472,637 | (10) |
| Lead—do | 1,973 | (10) | 5,009 | (10) |
| Zinc-lead—do | 500 | (10) | 120 | (10) |
| Peat—do | 3,739 | 20,741 | 4,057 | 23,131 |
| Petroleum—barrels | 214,773,000 | 215,900,000 | 238,521,000 | 242,100,000 |
| Platinum and allied metals—troy ounces | 799 | 38,127 | 568 | 32,773 |
| Potassium salts—short tons | (1) | (1) | (1) | (1) |
| Pumice—do | 23,775 | 155,228 | 24,206 | 124,970 |
| Pyrites—long tons | (1) | (1) | (1) | (1) |
| Salt—short tons | 368,290 | 2,576,873 | 370,911 | 1,817,830 |
| Sand and gravel—do | 12,627,423 | 6,138,579 | 12,575,937 | 6,749,768 |
| Sand and sandstone (finely ground)—do | (1) | (1) | (1) | (1) |
| Silica (quartz)—do | (1) | (1) | 746 | 6,072 |
| Silver—troy ounces | 2,103,799 | 1,629,392 | 2,888,265 | 2,234,073 |
| Slate | | 47,289 | | 39,694 |
| Sodium salts (carbonates and sulfates) (natural)—short tons | 136,376 | 1,268,014 | 182,609 | 1,777,266 |
| Stone—do | 12,826,370 | 10,163,893 | 8,356,260 | 7,007,329 |
| Sulfur—long tons | (1) | (1) | (1) | (1) |
| Sulfuric acid [11]—short tons | (1 5) | (1 5) | (1 5) | (1 5) |
| Talc and ground soapstone—do | 28,199 | 403,392 | 32,495 | 427,031 |
| Tripoli—do | (1) | (1) | 313 | 3,756 |
| Tungsten ore (60-percent concentrates)—do | (1) | (1) | 577 | (1) |
| Zinc—do | 8 | 800 | 20 | 2,600 |
| Miscellaneous [12] | | 8,442,060 | | 7,026,348 |
| Total value, eliminating duplications | | 437,565,809 | | 476,974,925 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Figures not available.
[10] Not valued as ore; value of recoverable metal content included under the metals.
[11] 1936: From zinc-roasting operation; 1937: From roasting of high-sulfide gold and silver concentrates.
[12] Includes minerals indicated by "1" above.

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*Mineral production of Colorado, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $1,208,257 | | [2] $1,446,433 |
| Raw (sold by producers)—short tons | 107,814 | 126,210 | 125,018 | 152,503 |
| Coal—do | [3] 6,811,802 | [3] 16,277,000 | [3] 7,187,211 | [4] 18,327,000 |
| Coke—do | 398,634 | ([5]) | 551,167 | ([5]) |
| Copper—pounds | 17,730,000 | 1,631,160 | 21,868,000 | 2,646,028 |
| Feldspar (crude)—long tons | 25,806 | 101,950 | 42,221 | 178,148 |
| Ferro-alloys—do | | | ([5]) | ([5]) |
| Fluorspar—short tons | 9,412 | (1) | 7,883 | 98,493 |
| Fuller's earth—do | (1) | (1) | (1) | (1) |
| Gems and precious stones | | ([6]) | | ([6]) |
| Gold—troy ounces | 366,607 | 12,831,245 | 368,905 | 12,911,675 |
| Gypsum—short tons | [7] 27,424 | ([7]) | [8] 28,586 | [8] 50,034 |
| Iron, pig—long tons | ([5]) | ([5]) | ([5]) | ([5]) |
| Lead—short tons | 7,267 | 668,564 | 9,786 | 1,154,748 |
| Lime—do | (1) | (1) | 7,163 | 72,831 |
| Manganiferous ore—long tons | 10,568 | (1) | 11,577 | 59,385 |
| Mica: | | | | |
| Scrap—short tons | (1) | (1) | (1) | (1) |
| Sheet—pounds | | | (1) | (1) |
| Mineral waters—gallons sold | ([6]) | ([6]) | ([6]) | ([6]) |
| Molybdenum—pounds | 16,001,816 | (1) | 23,566,481 | (1) |
| Natural gas—M cubic feet | 3,687,000 | 807,000 | 3,186,000 | 673,000 |
| Natural gasoline—gallons | 451,000 | 18,000 | 404,000 | 16,000 |
| Ores (crude), etc.: | | | | |
| Copper—short tons | 253,871 | ([9]) | 261,658 | ([9]) |
| Dry and siliceous (gold and silver)—do | 1,861,431 | ([9]) | 1,681,183 | ([9]) |
| Lead—do | 25,724 | ([9]) | 30,235 | ([9]) |
| Lead-copper—do | 910 | ([9]) | 537 | ([9]) |
| Zinc—do | | | 135 | ([9]) |
| Zinc-lead—do | 9,913 | ([9]) | 94,871 | ([9]) |
| Peat—do | (1) | (1) | (1) | (1) |
| Petroleum—barrels | 1,650,000 | 1,660,000 | 1,605,000 | 1,800,000 |
| Pyrites—long tons | 8,722 | (1) | 5,890 | (1) |
| Sand and gravel—short tons | 3,400,051 | 1,653,426 | 4,287,491 | 1,986,015 |
| Silver—troy ounces | 5,902,776 | 4,571,700 | 6,260,693 | 4,842,646 |
| Stone—short tons | 1,119,900 | 985,120 | [10] 1,018,100 | [10] 814,930 |
| Sulfur ore—long tons | 13 | (1) | 11 | (1) |
| Tantalum ore (columbo-tantalite)—pounds | | | (1) | (1) |
| Tungsten ore (60-percent concentrates)—short tons | 180 | 154,431 | 219 | (1) |
| Uranium and vanadium ores—do | (1) | (1) | (1) | (1) |
| Vermiculite—do | (1) | (1) | (1) | (1) |
| Zinc—do | 1,172 | 117,200 | 4,247 | 552,110 |
| Miscellaneous [11] | | 19,668,878 | | 28,139,619 |
| Total value, eliminating duplications | | 56,214,827 | | 67,338,548 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of marble and dimension limestone, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "[1]" and "[10]" above.

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*Mineral production of Connecticut, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1] $825,566 | | [1] $992,528 |
| Raw (sold by producers)—short tons | [2] | [2] | 3,156 | 3,944 |
| Coke—do | [2 3] | [2 3] | [2 3] | [2 3] |
| Feldspar (crude)—long tons | [2] | [2] | [2] | [2] |
| Lime—short tons | [2] | [2] | [2] | [2] |
| Mica: | | | | |
| Scrap—do | 705 | 11,741 | 561 | 8,616 |
| Sheet—pounds | 249,184 | 56,650 | 401,811 | 43,288 |
| Mineral waters—gallons sold | [4] | [4] | [4] | [4] |
| Sand and gravel—short tons | 1,213,726 | 516,013 | 1,293,617 | 573,643 |
| Stone—do | 1,626,850 | 1,756,193 | [5] 1,661,630 | [5] 1,859,648 |
| Miscellaneous [6] | | 3,221,898 | | 3,438,300 |
| Total value, eliminating duplications | | 3,317,494 | | 3,689,554 |

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of sandstone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "2" and "5" above.

*Mineral production of Delaware, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1 2] | | [2] $195,276 |
| Raw (sold by producers)—short tons | [1] | [1] | [1] | [1] |
| Sand and gravel—do | 83,667 | $51,794 | 83,994 | 47,468 |
| Stone—do | [1] | [1] | [1] | [1] |
| Miscellaneous [3] | | 392,299 | | 154,618 |
| Total value, eliminating duplications | | 444,093 | | 397,362 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Includes minerals indicated by "1" above.

*Mineral production of the District of Columbia, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay products (other than pottery and refractories) | | [1 2] | | [1 2] |
| Stone—short tons | | | [1] | [1] |
| Miscellaneous | | $547,576 | | $522,687 |
| Total value, eliminating duplications | | 547,576 | | 522,687 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.

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*Mineral production of Florida, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | (1 2) | | 2 $132,898 |
| Raw (sold by producers)—short tons | (1) | (1) | (1) | (1) |
| Diatomite—do | 275 | $27,500 | (1) | (1) |
| Fuller's earth—do | (1) | (1) | (1) | (1) |
| Lime—do | 16,407 | 150,524 | 19,008 | 177,929 |
| Mineral waters—gallons sold | (3) | (3) | (3) | (3) |
| Peat—short tons | (1) | (1) | (1) | (1) |
| Phosphate rock—long tons | 2,624,900 | 8,528,523 | 2,996,820 | 9,142,985 |
| Sand and gravel—short tons | 629,662 | 394,908 | 965,322 | 751,523 |
| Sand-lime brick—thousands | (1 2) | (1 2) | (1 2) | (1 2) |
| Stone—short tons | 1,595,280 | 1,620,428 | 1,600,380 | 1,408,749 |
| Miscellaneous 4 | | 2,251,360 | | 2,197,874 |
| Total value, eliminating duplications | | 12,973,243 | | 13,811,958 |

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 No canvass.
4 Includes minerals indicated by "1" above.

*Mineral production of Georgia, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Barite—short tons | 38,435 | $206,336 | 71,944 | $400,687 |
| Bauxite—long tons | (1) | (1) | (1) | (1) |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | 2 1,848,533 | | 2 2,118,952 |
| Raw (sold by producers)—short tons | 448,022 | 2,920,192 | 506,232 | 3,548,559 |
| Coal—do | 2 24,288 | 2 56,000 | (1 3) | (1 4) |
| Fuller's earth—do | (1) | (1) | (1) | (1) |
| Gems and precious stones | | (5) | | (5) |
| Gold—troy ounces | 450 | 15,735 | 743 | 25,995 |
| Iron ore—long tons | 5,740 | 11,408 | 14,593 | 19,130 |
| Kyanite—short tons | (6) | (6) | (6) | (6) |
| Lime—do | 8,271 | 45,478 | 7,964 | 62,196 |
| Manganese ore—long tons | 3,821 | 49,333 | 689 | 11,423 |
| Manganiferous ore—do | 3,144 | 12,020 | 9,537 | 28,459 |
| Mica: | | | | |
| Scrap—short tons | (1) | (1) | (1) | (1) |
| Sheet—pounds | (1) | (1) | (1) | (1) |
| Mineral waters—gallons sold | (5) | (5) | (5) | (5) |
| Ore (dry and siliceous) (gold and silver)—short tons | 190 | (7) | 1,406 | (7) |
| Sand and gravel—do | 319,849 | 140,156 | 429,122 | 211,026 |
| Silver—troy ounces | 28 | 21 | 49 | 38 |
| Slate | | (1) | | (1) |
| Stone—short tons | 1,422,240 | 4,122,706 | 1,737,760 | 3,597,039 |
| Talc—do | 11,473 | 114,545 | 11,984 | 148,177 |
| Miscellaneous 8 | | 2,214,129 | | 2,412,379 |
| Total value, eliminating duplications | | 11,756,592 | | 12,584,060 |

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to National Bituminous Coal Commission.
4 Value is estimated from various sources and includes selling expenses.
5 No canvass.
6 Figures not available.
7 Not valued as ore; value of recoverable metal content included under the metals.
8 Includes minerals indicated by "1" above.

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*Mineral production of Idaho, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Antimony ore (concentrates)—short tons | 3,787 | (1) | 3,295 | (1) |
| Arsenious oxide—do | (1) | (1) | (1) | (1) |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $104,908 | | [2] $139,054 |
| Raw (sold by producers)—short tons | (1) | (1) | (1) | (1) |
| Coal—do | [3] | [3] | [3] | [3] |
| Copper—pounds | 2,954,000 | 271,768 | 4,464,000 | 540,144 |
| Diatomite—short tons | | | 50 | 500 |
| Gems and precious stones | | [4] | | [4] |
| Gold—troy ounces | 80,291 | 2,810,199 | 81,861 | 2,865,135 |
| Gypsum—short tons | [5] | [5] | [5] | [5] |
| Lead—do | 91,339 | 8,403,188 | 103,711 | 12,237,898 |
| Lime—do | | | (1) | (1) |
| Ores (crude), etc.: | | | | |
| Copper—do | 284 | [6] | 850 | [6] |
| Dry and siliceous (gold and silver)—do | 515,138 | [6] | 531,514 | [6] |
| Lead—do | 305,967 | [6] | 412,378 | [6] |
| Zinc-lead—do | 986,141 | [6] | 1,130,660 | [6] |
| Phosphate rock—long tons | 47,113 | 203,264 | 83,436 | 356,037 |
| Sand and gravel—short tons | 1,479,322 | 760,761 | 1,722,201 | 728,988 |
| Silver—troy ounces | 14,537,530 | 11,259,317 | 19,587,766 | 15,151,137 |
| Stone—short tons | [7] 948,150 | [7] 688,860 | 891,270 | 700,627 |
| Tungsten ore (60-percent concentrates)—do | 11 | (1) | 99 | (1) |
| Zinc—do | 49,100 | 4,910,000 | 54,199 | 7,045,870 |
| Miscellaneous [8] | | 553,699 | | 867,729 |
| Total value, eliminating duplications | | 29,965,964 | | 40,633,119 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1" and "9" above.

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*Mineral production of Illinois, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | [1] 4,949,318 | [1] $7,056,344 | [1] 4,713,734 | [1] $6,756,747 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] 6,185,049 | | [2] 6,545,686 |
| Raw (sold by producers)—short tons | 126,396 | 278,996 | 161,537 | 339,706 |
| Coal—do | [3] 50,926,599 | [3] 81,444,000 | [3] 51,601,638 | [4] 89,271,000 |
| Coke—do | 2,082,516 | [5] 13,098,787 | 2,998,663 | [5] 20,213,129 |
| Fluorspar—do | 82,056 | 1,525,606 | 78,664 | 1,730,585 |
| Fuller's earth—do | (6) | (6) | (6) | (6) |
| Iron, pig—long tons | 2,991,740 | [5] 54,583,804 | 3,357,959 | [5] 70,893,278 |
| Lead—short tons | 294 | 27,048 | 186 | 21,948 |
| Lime—do | 144,675 | 1,057,765 | 142,122 | 1,039,087 |
| Mineral paints (zinc and lead pigments)—do | 18,162 | [5] 1,640,843 | 22,171 | [5] 2,406,423 |
| Mineral waters—gallons sold | (7) | (7) | (7) | (7) |
| Natural gas—M cubic feet | 865,000 | 433,000 | 1,040,000 | 533,000 |
| Natural gasoline—gallons | 2,337,000 | 134,000 | 2,567,000 | 153,000 |
| Ore (lead and zinc)—short tons | (8) | (8) | (8) | (8) |
| Petroleum—barrels | 4,475,000 | 5,390,000 | 7,499,000 | 9,970,000 |
| Pyrites—long tons | 9,472 | 15,660 | 10,220 | (6) |
| Sand and gravel—short tons | 12,418,495 | 6,017,468 | 14,333,482 | 7,486,610 |
| Sand and sandstone (finely ground)—do | 82,877 | 483,952 | 96,329 | 575,251 |
| Sand-lime brick—thousands | [2 6] | [2 6] | | |
| Silver—troy ounces | 1,780 | 1,379 | 887 | 686 |
| Stone—short tons | 9,359,170 | 7,295,011 | [9] 9,887,260 | [9] 8,383,931 |
| Sulfuric acid (60° Baumé) [10]—do | 140,857 | [5] 1,252,219 | 142,206 | [5] 1,326,782 |
| Tripoli—do | 10,981 | 138,063 | 11,647 | 151,154 |
| Miscellaneous [11] | | 432,787 | | 479,163 |
| Total value, eliminating duplications | | 117,916,128 | | 133,437,554 |

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] Value included under "Miscellaneous."
[7] No canvass.
[8] No ore milled in Northern Illinois; lead output of Southern Illinois is byproduct of fluorspar milling.
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] From zinc smelting.
[11] Includes minerals indicated by "1", "6", and "9" above.

*Mineral production of Indiana, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $4,480,778 | | [2] $4,670,619 |
| Raw (sold by producers)—short tons | 49,552 | 73,759 | 41,369 | 65,017 |
| Coal—do | [3] 17,822,536 | [3] 26,932,000 | [3] 17,764,774 | [4] 28,601,000 |
| Coke—do | 5,449,755 | [5] 40,627,036 | 5,467,061 | [5] 32,655,355 |
| Fuller's earth—do | (1) | (1) | | |
| Iron, pig—long tons | 3,256,677 | [5] 59,067,654 | 3,694,360 | [5] 77,990,597 |
| Lime—short tons | 93,370 | 559,048 | 94,053 | 552,243 |
| Marl, calcareous—do | | | (1) | (1) |
| Mineral paints (zinc and lead pigments)—do | (1 5) | (1 5) | (1 5) | (1 5) |
| Mineral waters—gallons sold | (6) | (6) | (6) | (6) |
| Natural gas—M cubic feet | 2,241,000 | 1,355,000 | 1,551,000 | 996,000 |
| Peat—short tons | (1) | (1) | | |
| Petroleum—barrels | 822,000 | 1,010,000 | 844,000 | 1,140,000 |
| Rubbing stones and whetstones—short tons | 95 | 14,401 | 115 | 18,288 |
| Sand and gravel—do | 6,938,235 | 3,340,781 | 6,598,723 | 3,227,514 |
| Sand-lime brick—thousands | (1 2) | (1 2) | (1 2) | (1 2) |
| Stone—short tons | 3,510,530 | 5,876,759 | [7] 3,504,530 | [7] 6,397,891 |
| Miscellaneous [8] | | 10,472,468 | | 10,769,362 |
| Total value, eliminating duplications | | 52,281,539 | | 54,886,756 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Exclusive of sandstone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

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*Mineral production of Iowa, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | 4,407,624 | $6,908,225 | 4,598,453 | $7,046,021 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1] 2,728,810 | | [1] 3,250,677 |
| Raw (sold by producers)—short tons | 4,411 | 46,023 | 4,600 | 50,871 |
| Coal—do | [2] 3,960,700 | [3] 9,940,000 | [2] 3,637,054 | [3] 9,529,000 |
| Ferro-alloys—long tons | [4] [5] | [4] [5] | [4] [5] | [4] [5] |
| Gypsum—short tons | [6] 344,221 | [6] 3,261,388 | [7] 387,255 | [7] 533,162 |
| Iron, pig—long tons | [4] [5] | [4] [5] | [4] [5] | [4] [5] |
| Mineral waters—gallons sold | [8] | [8] | [8] | [8] |
| Peat—short tons | [4] | [4] | [4] | [4] |
| Sand and gravel—do | 6,293,984 | 2,048,282 | 6,397,154 | 2,235,103 |
| Stone—do | [9] 4,003,550 | [9] 3,397,356 | 4,294,310 | 4,276,891 |
| Miscellaneous [10] | | 1,762,575 | | 2,163,370 |
| Total value, eliminating duplications | | 28,359,140 | | 26,941,350 |

[1] Figures obtained through cooperation with Bureau of the Census.
[2] According to National Bituminous Coal Commission.
[3] Value is estimated from various sources and includes selling expenses.
[4] Value included under "Miscellaneous."
[5] Value not included in total value for State.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] No canvass.
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "4" and "9" above.

*Mineral production of Kansas, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asphalt (native)—short tons | (1) | (1) | (1) | (1) |
| Cement—barrels | [2] 3,568,090 | [2] $5,550,200 | [2] 3,500,684 | [2] $5,482,851 |
| Chats—short tons | (3) | (3) | (3) | (3) |
| Clay products (other than pottery and refractories) | | [4] 1,061,448 | | [4] 1,408,376 |
| Coal—short tons | [5] 2,944,028 | [5] 5,394,000 | [5] 2,892,560 | [5] 5,612,000 |
| Gypsum—do | [1 7] | [1 7] | [1 8] | [1 8] |
| Lead—do | 11,409 | 1,049,628 | 16,008 | 1,888,944 |
| Mineral paints (zinc and lead pigments)—do | [1 9] | [1 9] | [1 9] | [1 9] |
| Mineral waters—gallons sold | [10] | [10] | [10] | [10] |
| Natural gas—M cubic feet | 69,178,000 | 23,126,000 | 83,890,000 | 30,376,000 |
| Natural gasoline—gallons | 37,775,000 | 1,542,000 | 57,026,000 | 2,192,000 |
| Ores (crude), etc.: | | | | |
| Zinc—short tons | 2,821,900 | [11] | 3,526,600 | [11] |
| Zinc-lead—do | 1,822,900 | [11] | 2,081,300 | [11] |
| Petroleum—barrels | 58,317,000 | 65,900,000 | 70,761,000 | 88,100,000 |
| Pumice—short tons | 42,057 | 117,757 | 38,438 | 111,655 |
| Pyrites—long tons | 6,902 | (1) | 15,843 | (1) |
| Salt—short tons | 704,164 | 2,580,166 | 654,089 | 2,759,062 |
| Sand and gravel—do | 2,454,017 | 920,730 | 2,495,196 | 1,017,515 |
| Stone—do | 4,934,510 | 5,747,261 | [12 3] 5,540,860 | [12 4] 4,763,080 |
| Zinc—do | 79,017 | 7,901,700 | 80,300 | 10,439,000 |
| Miscellaneous [13] | | 3,074,770 | | 2,788,921 |
| Total value, eliminating duplications | | 121,689,562 | | 154,376,403 |

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures not available.
[4] Figures obtained through cooperation with Bureau of the Census.
[5] According to National Bituminous Coal Commission.
[6] Value is estimated from various sources and includes selling expenses.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Value not included in total value for State.
[10] No canvass.
[11] Not valued as ore; value of recoverable metal content included under the metals.
[12] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[13] Includes minerals indicated by "1", "2", and "12" above.



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*Mineral production of Kentucky, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asphalt (native)—short tons | [1] | [1] | [1] | [1] |
| Cement—barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $1,224,578 | | [2] $1,220,962 |
| Raw (sold by producers)—short tons | 237,351 | 858,255 | 340,325 | 1,193,410 |
| Coal—do | [3] 47,521,950 | [3] 77,678,000 | [3] 47,086,444 | [4] 86,639,000 |
| Coke—do | [1 5] | [1 5] | [1 5] | [1 5] |
| Fluorspar—do | 80,241 | 1,409,433 | 87,296 | 1,710,122 |
| Fluorspar, optical—pounds | | | 50 | 120 |
| Iron, pig—long tons | 225,214 | [1 5] | 243,010 | [1 5] |
| Lead—short tons | 50 | 4,600 | 89 | 10,502 |
| Lime—do | [1] | [1] | [1] | [1] |
| Marl, calcareous—do | | | [1] | [1] |
| Mineral waters—gallons sold | [6] | [6] | [6] | [6] |
| Natural gas—M cubic feet | 43,903,000 | 19,200,000 | 55,719,000 | 22,904,000 |
| Natural gasoline—gallons | 6,009,000 | 346,000 | 7,344,000 | 382,000 |
| Ores (lead and zinc)—short tons | [7] | [7] | [7] | [7] |
| Petroleum—barrels | 5,633,000 | 7,240,000 | 5,484,000 | 7,680,000 |
| Sand and gravel—short tons | 1,272,267 | 915,664 | 1,100,682 | 804,210 |
| Stone—do | 2,836,860 | 2,396,842 | [8] 3,433,190 | [8] 3,040,322 |
| Zinc—do | 238 | 23,800 | 270 | 35,100 |
| Miscellaneous [9] | | 8,620,875 | | 8,134,709 |
| Total value, eliminating duplications | | 113,435,307 | | 127,423,680 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Figures not available.
[8] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "[1]" and "[8]" above.

*Mineral production of Louisiana, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | [1] | [1] | [1] | [1] |
| Clay products (other than pottery and refractories) | | [2] $237,671 | | [2] $489,255 |
| Mineral waters—gallons sold | [2] | [2] | [2] | [2] |
| Natural gas—M cubic feet | 290,151,000 | 53,641,000 | 315,301,000 | 53,908,000 |
| Natural gasoline—gallons | 72,687,000 | 2,945,000 | 106,415,000 | 4,300,000 |
| Petroleum—barrels | 80,491,000 | 85,600,000 | 90,924,000 | 110,300,000 |
| Salt—short tons | 918,414 | 2,436,971 | 974,403 | 2,898,826 |
| Sand and gravel—do | 2,078,546 | 1,467,690 | 2,065,447 | 1,250,439 |
| Stone—do | [1] | [1] | [1] | [1] |
| Sulfur—long tons | 333,475 | 5,980,101 | 429,602 | 7,705,448 |
| Miscellaneous [4] | | 1,049,964 | | 1,266,937 |
| Total value, eliminating duplications | | 153,358,397 | | 182,118,905 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Includes minerals indicated by "[1]" above.

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*Mineral production of Maine, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $343,217 | | [2] $358,589 |
| Raw (sold by producers)—short tons | (1) | (1) | (1) | (1) |
| Feldspar (crude)—long tons | 16,392 | 91,265 | 20,191 | 110,928 |
| Gems and precious stones | | [3] | | [3] |
| Lime—short tons | (1) | (1) | (1) | (1) |
| Mica, scrap—do | (1) | (1) | (1) | (1) |
| Mineral waters—gallons sold | [3] | [3] | [3] | [3] |
| Peat—short tons | (1) | (1) | (1) | (1) |
| Sand and gravel—do | 3,685,991 | 335,387 | 2,742,489 | 706,856 |
| Silica (quartz)—do | | | 67 | 168 |
| Slate | | 285,701 | | 388,521 |
| Stone—short tons | [4] 203,970 | [4] 1,401,234 | [4] 265,340 | [4] 1,546,037 |
| Miscellaneous [5] | | 966,549 | | 1,018,292 |
| Total value, eliminating duplications | | 3,423,353 | | 4,129,391 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "1" and "4" above.

*Mineral production of Maryland, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asbestos—short tons | (1) | (1) | (1) | (1) |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $1,320,662 | | [2] $1,313,811 |
| Raw (sold by producers)—short tons | 30,416 | 119,924 | 33,311 | 125,947 |
| Coal—do | [3] 1,703,589 | [3] 3,351,000 | [3] 1,548,980 | [4] 3,315,000 |
| Coke—do | 1,217,039 | (1 5) | 1,513,651 | (1 5) |
| Feldspar (crude)—long tons | (1) | (1) | (1) | (1) |
| Gold—troy ounces | 668 | 23,380 | 1,040 | 36,400 |
| Iron, pig—long tons | 1,219,852 | (1 5) | 1,514,372 | (1 5) |
| Lime—short tons | 50,410 | 324,209 | 59,575 | 404,562 |
| Mineral waters—gallons sold | [6] | [6] | [6] | [6] |
| Ore (dry and siliceous) (gold and silver)—short tons | 1,370 | [7] | 2,000 | [7] |
| Potassium salts—do | (1) | (1) | (1) | (1) |
| Sand and gravel—do | 2,200,176 | 2,056,614 | 2,441,612 | 2,236,132 |
| Silica (quartz)—do | 525 | 7,155 | 410 | 5,850 |
| Silver—troy ounces | 33 | 26 | 40 | 31 |
| Slate | | (1) | | (1) |
| Stone—short tons | [8] 1,423,110 | [8] 1,735,306 | [8] 836,800 | [8] 1,139,767 |
| Talc—do | (1) | (1) | (1) | (1) |
| Miscellaneous [9] | | 31,669,981 | | 41,790,766 |
| Total value, eliminating duplications | | 11,157,550 | | 10,634,854 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of marble, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

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*Mineral production of Massachusetts, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1] $807,568 | | [1] $804,895 |
| Raw (sold by producers) short tons | 1,344 | 12,570 | 2,125 | 17,868 |
| Coke do | 1,108,219 | [2] 6,766,722 | 1,130,620 | ([2] [3]) |
| Diatomite do | | | ([3]) | ([3]) |
| Fuller's earth do | ([3]) | ([3]) | | |
| Iron, pig long tons | ([2] [3]) | ([2] [3]) | ([2] [3]) | ([2] [3]) |
| Lime short tons | 92,625 | 839,948 | 101,247 | 897,356 |
| Mineral waters gallons sold | ([4]) | ([4]) | ([4]) | ([4]) |
| Peat short tons | ([3]) | ([3]) | ([3]) | ([3]) |
| Sand and gravel do | 2,734,346 | 1,133,006 | 2,884,784 | 1,421,390 |
| Sand and sandstone (finely ground) do | 543 | 3,324 | 2,613 | 12,448 |
| Sand-lime brick thousands | ([1] [3]) | ([1] [3]) | [1] 18,741 | [1] 168,672 |
| Stone short tons | [5] 2,420,420 | [5] 4,608,010 | [5] 2,353,500 | [5] 4,408,297 |
| Miscellaneous [6] | | 767,327 | | 9,083,198 |
| Total value, eliminating duplications | | 7,559,253 | | 7,813,345 |

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] Value included under "Miscellaneous."
[4] No canvass.
[5] Exclusive of sandstone in 1936 and of marble in 1937, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "[3]" and "[5]" above.

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*Mineral production of Michigan, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Bromine—pounds | 12,421,677 | $2,498,545 | 13,494,677 | $2,697,666 |
| Calcium chloride—short tons | [1] | [1] | 84,527 | 1,213,985 |
| Cement—barrels | 7,960,821 | 10,482,835 | 7,831,880 | 9,836,999 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] 1,513,643 | | [2] 1,838,709 |
| Raw (sold by producers)—short tons | [1] | [1] | [1] | [1] |
| Coal—do | [3] 626,145 | [3] 2,118,000 | [3] 562,262 | [4] 2,047,000 |
| Coke—do | 2,293,653 | [5] 13,738,700 | 2,283,518 | [5] 13,816,401 |
| Copper—pounds | 95,968,019 | 8,829,058 | 94,928,000 | 11,486,288 |
| Gems and precious stones | | [6] | | [6] |
| Gold—troy ounces | | | 51 | 1,800 |
| Graphite, amorphous—short tons | | | [1] | [1] |
| Gypsum—do | [7] 496,611 | [7] 4,748,950 | [8] 553,242 | [8] 896,947 |
| Iron: | | | | |
| Ore— | | | | |
| Sold to furnaces—long tons | 10,491,270 | 30,721,075 | 12,626,935 | 41,136,202 |
| Sold for paint—do | 897 | [1] | 1,118 | [1] |
| Pig—do | 873,341 | [5] 13,585,519 | 886,602 | [5] 15,064,083 |
| Lime—short tons | 40,090 | 286,348 | 48,310 | 351,681 |
| Magnesium—pounds | 3,903,312 | [1] | 4,539,980 | [1] |
| Magnesium salts (natural): | | | | |
| Carbonate—do | [1] | [1] | [1] | [1] |
| Chloride—do | [1] | [1] | [1] | [1] |
| Sulfate—do | [1] | [1] | [1] | [1] |
| Manganiferous ore—long tons | 9,627 | 29,775 | 9,739 | 32,442 |
| Marl, calcareous—short tons | [1] | [1] | 1,270 | 553 |
| Mineral waters—gallons sold | [6] | [6] | [6] | [6] |
| Natural gas—M cubic feet | 7,167,000 | 3,549,000 | 9,080,000 | 5,640,000 |
| Natural gasoline—gallons | 2,015,000 | 106,000 | 2,408,000 | 103,000 |
| Ores (crude), etc.: | | | | |
| Copper—short tons | 3,225,600 | [9] | 4,197,881 | [9] |
| Dry and siliceous (gold and silver)—do | | | 600 | [9] |
| Peat—do | 5,489 | 40,295 | 5,276 | 28,832 |
| Petroleum—barrels | 11,928,000 | 15,950,000 | 16,628,000 | 21,950,000 |
| Salt—short tons | 2,354,282 | 5,882,718 | 2,476,406 | 6,506,120 |
| Sand and gravel—do | 10,862,851 | 4,310,931 | 10,087,148 | 4,430,584 |
| Sand-lime brick—thousands | [2] 25,191 | [2] 226,651 | [2] 16,107 | [2] 144,597 |
| Silver—troy ounces | | | 25,454 | 19,689 |
| Stone—short tons | 10,690,410 | 5,391,789 | [10] 12,347,790 | [10] 6,553,610 |
| Miscellaneous [11] | | 3,960,879 | | 2,250,869 |
| Total value, eliminating duplications | | 100,646,492 | | 119,167,573 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of sandstone, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "[1]" and "[10]" above.

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*Mineral production of Minnesota, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement.....barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories).. | ---------- | [2] $1,048,507 | ---------- | [2] $962,572 |
| Raw (sold by producers).....short tons | 3,579 | 7,663 | 3,116 | 6,250 |
| Coke.....do | 521,518 | [3] 4,120,984 | 704,631 | [3] 5,611,287 |
| Flint lining for tube mills.....do | [1] | [1] | [1] | [1] |
| Gems and precious stones | ---------- | [4] | ---------- | [4] |
| Iron: | | | | |
| Ore— | | | | |
| Sold to furnaces.....long tons | 32,938,883 | 83,523,720 | 47,878,042 | 141,542,594 |
| Sold for paint.....do | 1,903 | [1] | ---------- | ---------- |
| Pig.....do | 101,475 | [1 3] | 248,363 | [1 3] |
| Lime.....short tons | [1] | [1] | [1] | [1] |
| Manganiferous ore.....long tons | 888,521 | [1] | 1,257,900 | 3,451,795 |
| Marl, calcareous.....short tons | [1] | [1] | 340 | 290 |
| Mineral waters.....gallons sold | [4] | [4] | [4] | [4] |
| Peat.....short tons | [1] | [1] | [1] | [1] |
| Pebbles for grinding.....do | [1] | [1] | [1] | [1] |
| Sand and gravel.....do | 7,342,987 | 2,692,223 | 7,781,830 | 1,905,441 |
| Sand-lime brick.....thousands | [1 3] | [1 3] | [2] 16,880 | [2] 127,829 |
| Stone.....short tons | 982,690 | 2,526,869 | [5] 822,680 | [5] 1,991,199 |
| Miscellaneous [6] | ---------- | 6,754,802 | ---------- | 7,503,912 |
| Total value, eliminating duplications | ---------- | 94,568,991 | ---------- | 152,107,070 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of marble, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "[1]" and "[3]" above.

*Mineral production of Mississippi, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay: | | | | |
| Products (other than pottery and refractories) | ---------- | [1] $588,025 | ---------- | [1] $623,023 |
| Raw (sold by producers).....short tons | [2] | [2] | [2] | [2] |
| Fuller's earth.....do | ---------- | ---------- | [2] | [2] |
| Iron ore.....long tons | ---------- | ---------- | 97 | [2] |
| Mineral waters.....gallons sold | [3] | [3] | [3] | [3] |
| Natural gas.....M cubic feet | 11,821,000 | 2,646,000 | 13,348,000 | 3,041,000 |
| Sand and gravel.....short tons | 1,136,841 | 549,794 | 2,814,696 | 1,008,722 |
| Stone.....do | [2] | [3] | [2] | [2] |
| Miscellaneous [4] | ---------- | 62,285 | ---------- | 149,205 |
| Total value, eliminating duplications | ---------- | 3,846,104 | ---------- | 4,821,950 |

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] Includes minerals indicated by "[2]" above.

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*Mineral production of Missouri, 1936–37*

| Product | | 1936 | | 1937 | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| Asphalt (native) | short tons | [1] | [1] | [1] | [1] |
| Barite | do | 160,866 | $1,008,528 | 198,101 | $1,430,397 |
| Cement | barrels | 4,632,191 | 7,134,240 | 4,565,448 | 7,041,016 |
| Chats | short tons | 2,784,800 | 485,000 | 1,984,340 | 213,436 |
| Clay: | | | | | |
| Products (other than pottery and refractories) | | | [2] 2,425,985 | | [2] 2,542,404 |
| Raw (sold by producers) | short tons | 472,246 | 1,336,382 | 519,561 | 1,529,239 |
| Coal | do | [3] 3,984,999 | [3] 7,559,000 | [3] 4,091,394 | [4] 7,978,000 |
| Coke | do | [1 5] | [1 5] | [1 5] | [1 5] |
| Copper | pounds | 382,000 | 35,144 | 538,000 | 65,098 |
| Iron ore— | | | | | |
| Sold to furnaces | long tons | 2,933 | 16,566 | 19,897 | 57,687 |
| Sold for paint | do | 837 | [1] | 1,500 | [1] |
| Lead | short tons | 110,428 | 10,159,376 | 157,631 | 18,600,458 |
| Lime | do | 379,354 | 2,047,189 | 426,514 | 2,326,928 |
| Mineral paints (zinc and lead pigments) | do | [1 5] | [1 5] | [1 5] | [1 5] |
| Mineral waters | gallons sold | [6] | [6] | [6] | [6] |
| Natural gas | M cubic feet | 399,000 | 196,000 | 444,000 | 226,000 |
| Ores (crude), etc.: | | | | | |
| Lead | short tons | 3,420,600 | [7] | 5,012,631 | [7] |
| Zinc | do | 408,700 | [7] | 438,100 | [7] |
| Zinc-lead | do | 460,700 | [7] | 542,000 | [7] |
| Petroleum | barrels | 40,000 | 35,000 | 40,000 | 42,000 |
| Pyrites | long tons | 27,293 | 77,660 | [1] | [1] |
| Sand and gravel | short tons | 4,074,565 | 2,402,304 | 4,409,708 | 2,481,464 |
| Sand and sandstone (finely ground) | do | [1] | [1] | [1] | [1] |
| Sand-lime brick | thousands | [1 2] | [1 2] | [1 2] | [1 2] |
| Silver | troy ounces | 163,720 | 126,801 | 179,700 | 138,999 |
| Stone | short tons | [8] 3,443,930 | [8] 4,142,950 | [8] 3,635,250 | [8] 4,742,459 |
| Tripoli | do | [1] | [1] | [1] | [1] |
| Tungsten ore (60-percent concentrates) | do | | | [1] | [1] |
| Zinc | do | 18,709 | 1,870,900 | 20,600 | 2,678,000 |
| Miscellaneous [9] | | | 1,729,945 | | 2,243,344 |
| Total value, eliminating duplications | | | 41,350,860 | | 52,446,272 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of unclassified stone in 1936 and of sandstone in 1937, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

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*Mineral production of Montana, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Arsenious oxide ..... short tons | [1] | [1] | [1] | [1] |
| Asbestos ..... do | [1] | [1] | [1] | [1] |
| Cement ..... barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $235, 151 | | [2] $151, 529 |
| Raw (sold by producers) ..... short tons | [1] | [1] | 8, 645 | 7, 111 |
| Coal ..... do | [2] 2, 988, 524 | [3] 4, 437, 000 | [3] 2, 965, 193 | [4] 4, 423, 000 |
| Copper ..... pounds | 219, 088, 000 | 20, 156, 096 | 289, 056, 000 | 34, 975, 776 |
| Gems and precious stones | | [5] | | [5] |
| Gold ..... troy ounces | 180, 209 | 6, 307, 322 | 202, 252 | 7, 078, 820 |
| Graphite, crystalline ..... pounds | [1] | [1] | [1] | [1] |
| Gypsum ..... short tons | [1 6] | [1 6] | [1 7] | [1 7] |
| Lead ..... do | 19, 059 | 1, 753, 428 | 17, 957 | 2, 118, 926 |
| Lime ..... do | 10, 962 | 75, 867 | 13, 295 | 79, 201 |
| Manganese ore ..... long tons | 16, 456 | 487, 419 | 26, 744 | 785, 129 |
| Manganiferous ore ..... do | 20, 307 | 86, 037 | 19, 660 | 114, 692 |
| Mineral waters ..... gallons sold | [5] | [5] | [5] | [5] |
| Natural gas ..... M cubic feet | 23, 003, 000 | 6, 217, 000 | 24, 765, 000 | 6, 667, 000 |
| Natural gasoline ..... gallons | 2, 071, 000 | 100, 000 | 2, 296, 000 | 161, 000 |
| Ores (crude), etc.: | | | | |
| Copper ..... short tons | 2, 429, 529 | [8] | 3, 426, 395 | [8] |
| Dry and siliceous (gold and silver) ..... do | 798, 554 | [8] | 904, 489 | [8] |
| Lead ..... do | 4, 036 | [8] | 13, 867 | [8] |
| Zinc ..... do | 93, 902 | [8] | 125, 395 | [8] |
| Zinc-lead ..... do | 527, 095 | [8] | 427, 863 | [8] |
| Petroleum ..... barrels | 5, 868, 000 | 7, 700, 000 | 5, 805, 000 | 7, 300, 000 |
| Phosphate rock ..... long tons | 36, 022 | 76, 066 | 50, 834 | 133, 138 |
| Pyrites ..... do | [1] | [1] | [1] | [1] |
| Sand and gravel ..... short tons | 5, 318, 312 | 1, 699, 775 | 4, 601, 999 | 1, 590. 403 |
| Silver ..... troy ounces | 11, 600, 563 | 8, 984, 636 | 11, 812, 093 | 9, 136, 654 |
| Stone ..... short tons | 357, 140 | 276, 938 | [9] 340, 450 | [9] 439, 785 |
| Tungsten ore (60-percent concentrates) ..... do | [1] | [1] | 14 | [1] |
| Vermiculite ..... do | [1] | [1] | [1] | [1] |
| Zinc ..... do | 49, 717 | 4, 971, 700 | 39, 168 | 5, 091. 840 |
| Miscellaneous [10] | | 2, 004, 715 | | 1, 832, 811 |
| Total value, eliminating duplications | | 65, 569, 150 | | 82, 086. 815 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "[1]" and "[9]" above.

*Mineral production of Nebraska, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement ..... barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1 2] | | [2] $473, 227 |
| Raw (sold by producers) ..... short tons | 8, 278 | $10, 535 | 6, 904 | 8, 371 |
| Mineral waters ..... gallons sold | [3] | [3] | [3] | [3] |
| Pumice ..... short tons | [1] | [1] | 5, 777 | 38, 130 |
| Sand and gravel ..... do | 1, 971, 986 | 751, 178 | 2, 850, 963 | 1, 061, 589 |
| Stone ..... do | 259, 390 | 388, 800 | 763, 710 | 1, 146, 335 |
| Miscellaneous | | 2, 693, 049 | | 2, 110, 157 |
| Total value, eliminating duplications | | 3, 843, 562 | | 4, 837, 809 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.

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*Mineral production of Nevada, 1936–37*

| Product | | 1936 | | 1937 | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| Antimony ore | short tons | 80 | [1] | 38 | $300 |
| Barite | do | [1] | [1] | [1] | [1] |
| Clay: | | | | | |
| Products (other than pottery and refractories) | | | | | [1 2] |
| Raw (sold by producers) | short tons | | | [1] | [1] |
| Copper | pounds | 141,392,000 | $13,008,064 | 149,206,000 | 18,053,926 |
| Diatomite | short tons | 249 | 6,866 | 275 | 8,180 |
| Fluorspar | do | 2,126 | [1] | 2,544 | [1] |
| Fuller's earth | do | [1] | [1] | 4,485 | 51,718 |
| Gems and precious stones | | | [3] | | [3] |
| Gold | troy ounces | 286,370 | 10,022,950 | 281,332 | 9,846,620 |
| Graphite, amorphous | short tons | [1] | [1] | [1] | [1] |
| Gypsum | do | [4] 167,342 | [1 4] | [5] 160,347 | [5] 268,638 |
| Iron ore | long tons | 340 | [1] | 196 | [1] |
| Lead | short tons | 10,712 | 985,504 | 9,347 | 1,102,946 |
| Lime | do | [1] | [1] | [1] | [1] |
| Magnesium oxide (hydrated) (brucite) | do | [1] | [1] | [1] | [1] |
| Manganiferous ore | long tons | | | 533 | 3,167 |
| Marl, calcareous | short tons | [1] | [1] | [1] | [1] |
| Mercury | flasks (76 pounds) | 211 | 16,863 | 198 | 17,855 |
| Mineral waters | gallons sold | [3] | [3] | [3] | [3] |
| Molybdenum | pounds | [1] | [1] | | |
| Ores (crude), etc.: | | | | | |
| Copper | short tons | 4,668,590 | [6] | 5,669,388 | [6] |
| Dry and siliceous (gold and silver) | do | 1,725,498 | [6] | 1,729,048 | [6] |
| Lead | do | 25,247 | [6] | 11,218 | [6] |
| Lead-copper | do | 75 | [6] | 1,003 | [6] |
| Zinc | do | | | 103,305 | [6] |
| Zinc-lead | do | 164,728 | [6] | 51,504 | [6] |
| Sand and gravel | do | 1,863,678 | 693,105 | 1,710,819 | 785,947 |
| Silver | troy ounces | 5,068,786 | 3,925,775 | 4,864,750 | 3,762,884 |
| Sodium sulfate (natural) | short tons | [1] | [1] | | |
| Stone | do | 521,760 | 304,668 | [7] 76,340 | [7] 66,217 |
| Sulfur ore | long tons | | | 210 | [1] |
| Tungsten ore (60-percent concentrates) | short tons | 1,631 | [1] | 2,153 | [1] |
| Vanadium ores | do | 147 | [1] | | |
| Zinc | do | 13,477 | 1,347,700 | 14,236 | 1,850,680 |
| Miscellaneous [8] | | | 2,381,634 | | 3,052,738 |
| Total value, eliminating duplications | | | 32,693,129 | | 38,871,816 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[5] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of limestone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "[1]" and "[7]" above.

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*Mineral production of New Hampshire, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay products (other than pottery and refractories) | | [1] $324,155 | | [1] $300,219 |
| Diatomite short tons | | | [2] | [2] |
| Feldspar (crude) long tons | 26,494 | 157,729 | 28,831 | 155,925 |
| Fluorspar short tons | 257 | [2] | 478 | [2] |
| Garnet, abrasive do | [3] | [2] | [3] | [2] |
| Gems and precious stones | | [3] | | [3] |
| Mica: | | | | |
| Scrap short tons | 250 | 3,610 | 306 | 4,397 |
| Sheet pounds | 285,822 | 22,920 | 235,055 | 20,119 |
| Mineral waters gallons sold | [3] | [3] | [3] | [3] |
| Peat short tons | [3] | [3] | [3] | [3] |
| Sand and gravel do | 2,509,255 | 264,117 | 2,207,922 | 252,784 |
| Scythestones do | [3] | [3] | [3] | [3] |
| Silica (quartz) do | | | 29 | 75 |
| Stone do | 81,660 | 374,401 | 71,090 | 442,772 |
| Miscellaneous [4] | | 35,123 | | 43,578 |
| Total value, eliminating duplications | | 1,182,055 | | 1,219,869 |

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] Includes minerals indicated by "[2]" above.

*Mineral production of New Jersey, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $4,794,622 | | [2] $6,395,790 |
| Raw (sold by producers) short tons | 99,250 | 532,117 | 97,978 | 514,840 |
| Coke do | 1,007,500 | [1 3] | 1,015,073 | [1 3] |
| Diatomite do | [1] | [1] | [1] | [1] |
| Ferro-alloys long tons | [1 3] | [1 3] | [1 3] | [1 3] |
| Fuller's earth short tons | [1] | [1] | | |
| Iron ore long tons | 194,295 | [1] | 544,635 | 2,474,087 |
| Lime short tons | 14,658 | 99,891 | 20,029 | 151,350 |
| Manganiferous residuum long tons | 124,288 | [1] | 115,998 | [1] |
| Marl, greensand short tons | 8,368 | 177,835 | 9,734 | 210,974 |
| Mineral paints (zinc and lead pigments) do | [1 3] | [1 3] | | |
| Mineral waters gallons sold | [4] | [4] | [4] | [4] |
| Ore (zinc) short tons | 526,233 | [5] | 590,900 | [5] |
| Peat do | [1] | [1] | 13,175 | 72,768 |
| Sand and gravel do | 3,742,908 | 2,904,609 | 4,187,492 | 3,347,390 |
| Sand and sandstone (finely ground) do | 77,584 | 363,323 | 82,398 | 430,743 |
| Sand-lime brick thousands | [1 2] | [1 2] | [1 2] | [1 2] |
| Silica (quartz) short tons | [1] | [1] | | |
| Stone do | 2,089,960 | 2,608,859 | [6] 2,379,590 | [6] 2,621,038 |
| Zinc [7] do | 89,883 | 9,868,010 | 101,408 | 13,461,309 |
| Miscellaneous [8] | | 9,745,174 | | 8,393,235 |
| Total value, eliminating duplications | | 24,421,046 | | 31,467,931 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metal.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] Value reported for zinc in New Jersey is estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[8] Includes minerals indicated by "[1]" and "[6]" above.

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*Mineral production of New Mexico, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asphalt (native)—short tons | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $147,383 | | [1 2] |
| Raw (sold by producers)—short tons | 25,468 | 88,102 | 23,571 | $114,914 |
| Coal—do | [3] 1,596,775 | [3] 4,325,000 | [3] 1,714,955 | [4] 4,973,000 |
| Copper—pounds | 6,332,000 | 582,544 | 64,106,000 | 7,756,826 |
| Fluorspar—short tons | 2,045 | [1] | 3,324 | [1] |
| Gems and precious stones | | [5] | | [5] |
| Gold—troy ounces | 33,037 | 1,156,295 | 41,171 | 1,440,985 |
| Iron ore—long tons | 17,550 | [1] | 10,497 | [1] |
| Lead—short tons | 6,626 | 609,592 | 6,512 | 768,416 |
| Lime—do | [1] | [1] | 902 | 8,900 |
| Manganese ore—long tons | | | 878 | [1] |
| Manganiferous ore—do | 170 | [1] | 18,581 | [1] |
| Mica: | | | | |
| Scrap—short tons | [1] | [1] | [1] | [1] |
| Sheet—pounds | [1] | [1] | [1] | [1] |
| Mineral waters—gallons sold | [5] | [5] | [5] | [5] |
| Molybdenum—pounds | [1] | [1] | [1] | [1] |
| Natural gas—M cubic feet | 33,928,000 | 5,489,000 | 46,337,000 | 7,699,000 |
| Natural gasoline—gallons | 28,921,000 | 999,000 | 38,253,000 | 1,493,000 |
| Ores (crude), etc.: | | | | |
| Copper—short tons | 31,056 | [6] | 3,631,454 | [6] |
| Dry and siliceous (gold and silver)—do | 122,096 | [6] | 134,253 | [6] |
| Lead—do | 450 | [6] | 1,853 | [6] |
| Lead-copper—do | 950 | [6] | 396 | [6] |
| Zinc—do | 287,460 | [6] | 170,510 | [6] |
| Zinc-lead—do | | | 252,626 | [6] |
| Zinc-lead-copper—do | 72,954 | [6] | | |
| Petroleum—barrels | 27,223,000 | 22,930,000 | 38,854,000 | 36,600,000 |
| Potassium salts—short tons | [1] | [1] | [1] | [1] |
| Pumice—do | [1] | [1] | [1] | [1] |
| Salt—do | [1] | [1] | [1] | [1] |
| Sand and gravel—do | 2,062,411 | 1,575,797 | 1,686,727 | 974,763 |
| Silver—troy ounces | 1,163,255 | 900,941 | 1,243,766 | 962,053 |
| Stone—short tons | 1,078,570 | 862,059 | 713,500 | 302,723 |
| Tantalum ore (columbo-tantalite)—pounds | | | [1] | [1] |
| Tin (metallic equivalent)—do | | | [1] | [1] |
| Tungsten ore (60-percent concentrates)—short tons | [1] | [1] | [1] | [1] |
| Zinc—do | 20,668 | 2,066,800 | 23,927 | 3,110,510 |
| Miscellaneous [7] | | 4,209,493 | | 6,650,655 |
| Total value, eliminating duplications | | 45,942,006 | | 72,855,745 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "!" above.

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*Mineral production of New York, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Aluminum pounds | [1 2] | [1 2] | [1 2] | [1 2] |
| Cement barrels | [3] 5,651,412 | [3] $8,794,448 | [3] 6,106,083 | [3] $8,825,785 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [4] 4,280,059 | | [4] 5,435,096 |
| Raw (sold by producers) short tons | 3,940 | 25,393 | 6,465 | 41,020 |
| Coke do | 4,835,921 | [3] 28,566,271 | 4,946,964 | [3] 29,853,516 |
| Diatomite do | (1) | (1) | (1) | (1) |
| Emery do | 325 | 2,900 | 320 | 2,780 |
| Feldspar (crude) long tons | (1) | (1) | (1) | (1) |
| Ferro-alloys do | 187,016 | [3] 16,346,231 | 166,137 | [3] 18,079,832 |
| Garnet, abrasive short tons | (1) | (1) | (1) | (1) |
| Graphite, artificial pounds | [1 2] | [1 2] | [1 2] | [1 2] |
| Gypsum short tons | [5] 609,204 | [5] 6,585,277 | [6] 700,357 | [6] 1,107,175 |
| Iron: | | | | |
| Ore— | | | | |
| Sold to furnaces long tons | 801,236 | (1) | (1) | (1) |
| Sold for paint do | (1) | (1) | (1) | (1) |
| Pig do | 2,216,751 | [3] 35,181,959 | 2,702,072 | [3] 55,789,609 |
| Lead short tons | (1) | (1) | (1) | (1) |
| Lime do | 68,068 | 527,009 | 55,947 | 438,151 |
| Millstones | | 5,458 | | (1) |
| Mineral waters gallons sold | (7) | (7) | (7) | (7) |
| Natural gas M cubic feet | 12,431,000 | 8,645,000 | 21,325,000 | 12,388,000 |
| Natural gasoline gallons | 22,000 | 2,000 | 33,000 | 2,000 |
| Ores (crude), etc.: | | | | |
| Zinc short tons | 92,749 | (8) | 112,478 | (8) |
| Zinc-lead do | 284,702 | (8) | 352,392 | (8) |
| Peat do | 11,906 | 25,888 | 10,928 | 23,788 |
| Petroleum barrels | 4,663,000 | 11,380,000 | 5,478,000 | 14,140,000 |
| Pyrites long tons | 62,530 | (1) | 74,834 | (1) |
| Salt short tons | 2,021,983 | 5,609,932 | 2,084,867 | 5,795,551 |
| Sand and gravel do | 11,829,226 | 6,625,507 | 12,501,388 | 6,487,234 |
| Sand-lime brick thousands | [1 4] | [1 4] | [1 4] | [1 4] |
| Silica (quartz) short tons | (1) | (1) | (1) | (1) |
| Silver troy ounces | 18,251 | 14,135 | 41,500 | 32,100 |
| Slate | | 347,530 | | 360,064 |
| Stone short tons | 9,411,430 | 10,033,309 | 10,882,980 | 11,244,495 |
| Talc do | 85,429 | 1,043,232 | 96,140 | 1,215,834 |
| Zinc do | 26,941 | 2,694,100 | 32,690 | 4,249,700 |
| Miscellaneous [9] | | 26,715,538 | | 33,773,381 |
| Total value, eliminating duplications | | 71,647,775 | | 77,665,874 |

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of natural cement, value for which is included under "Miscellaneous."
[4] Figures obtained through cooperation with Bureau of the Census.
[5] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[6] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "1" and "8" above.

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*Mineral production of North Carolina, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Aluminum ..... pounds | (1 2) | (1 2) | (1 2) | (1 2) |
| Asbestos ..... short tons | (1) | (1) | (1) | (1) |
| Bromine ..... pounds | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) ..... | ..... | [3] $3,080,434 | ..... | [3] $3,263,898 |
| Raw (sold by producers) ..... short tons | 8,832 | 126,703 | 9,832 | 144,639 |
| Copper ..... pounds | (1) | (1) | (1) | (1) |
| Feldspar (crude) ..... long tons | 102,393 | 591,053 | 94,595 | 538,567 |
| Garnet, abrasive ..... short tons | (1) | (1) | (1) | (1) |
| Gems and precious stones ..... | ..... | (4) | ..... | (4) |
| Gold ..... troy ounces | 2,037 | 71,301 | 949 | 33,203 |
| Iron ore ..... long tons | 57 | 225 | ..... | ..... |
| Kyanite ..... short tons | (5) | (5) | (5) | (5) |
| Lead ..... do | (1) | (1) | ..... | ..... |
| Lime ..... do | (1) | (1) | (1) | (1) |
| Marl, calcareous ..... do | ..... | ..... | (1) | (1) |
| Mica: | | | | |
| Scrap ..... do | 10,840 | 131,138 | 12,988 | 209,212 |
| Sheet ..... pounds | 730,446 | 119,653 | 1,044,328 | 218,176 |
| Mineral waters ..... gallons sold | (4) | (4) | (4) | (4) |
| Olivine ..... short tons | (5) | (5) | (5) | (5) |
| Ores (crude): | | | | |
| Copper ..... do | 19,148 | (6) | 22,015 | (6) |
| Dry and siliceous (gold and silver) ..... do | 12,457 | (6) | 5,209 | (6) |
| Sand and gravel ..... do | 1,515,829 | 528,499 | 1,824,082 | 539,501 |
| Sand and sandstone (finely ground) ..... do | ..... | ..... | (1) | (1) |
| Silica (quartz) ..... do | 1,005 | 11,398 | 792 | 6,261 |
| Silver ..... troy ounces | 5,575 | 4,318 | 5,538 | 4,284 |
| Stone ..... short tons | 2,724,140 | 3,397,707 | 2,624,770 | 3,314,634 |
| Talc and pyrophyllite ..... do | 27,877 | 280,026 | 28,250 | 271,013 |
| Tantalum ore (columbo-tantalite) ..... pounds | ..... | ..... | (1) | (1) |
| Vermiculite ..... short tons | (1) | (1) | ..... | ..... |
| Miscellaneous [7] ..... | ..... | 9,515,064 | ..... | 13,049,056 |
| Total value, eliminating duplications ..... | ..... | 9,955,519 | ..... | 11,160,444 |

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Figures not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

*Mineral production of North Dakota, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay: | | | | |
| Products (other than pottery and refractories) ..... | ..... | (1 2) | ..... | (1 2) |
| Raw (sold by producers) ..... short tons | (1) | (1) | (1) | (1) |
| Coal ..... do | 2,215,335 | $2,534,000 | 2,250,837 | $2,639,000 |
| Mineral waters ..... gallons sold | (3) | (3) | (3) | (3) |
| Sand and gravel ..... short tons | 1,848,463 | 215,630 | 1,864,038 | 127,799 |
| Stone ..... do | ..... | ..... | 44,570 | 15,012 |
| Miscellaneous [4] ..... | ..... | 152,823 | ..... | 91,200 |
| Total value, eliminating duplications ..... | ..... | 2,902,453 | ..... | 2,873,011 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Includes minerals indicated by "1" above.

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*Mineral production of Ohio, 1936–37*

| Product | | 1936 | | 1937 | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| Asphalt (native) | short tons | [1] | [1] | | |
| Bromine | pounds | [1] | [1] | | |
| Calcium chloride | short tons | [1] | [1] | [1] | [1] |
| Cement | barrels | [2] 5,546,500 | [2] $7,741,485 | [2] 5,501,769 | [2] $7,771,268 |
| Clay: | | | | | |
| Products (other than pottery and refractories) | | | [3] 20,100,873 | | [3] 23,327,740 |
| Raw (sold by producers) | short tons | 409,361 | 865,976 | 452,258 | 1,001,343 |
| Coal | do | [4] 24,110,078 | [4] 38,838,000 | [4] 25,177,867 | [5] 44,313,000 |
| Coke | do | 6,242,300 | [6] 26,938,007 | 6,737,881 | [6] 32,185,945 |
| Ferro-alloys | long tons | 106,095 | [6] 4,451,512 | 156,653 | [6] 6,229,723 |
| Grindstones | short tons | 10,448 | 327,637 | 11,046 | 340,348 |
| Gypsum | do | [1 7] | [1 7] | [1 8] | [1 8] |
| Iron, pig | long tons | 7,351,407 | [6] 125,087,158 | 7,724,882 | [6] 167,076,855 |
| Lime | short tons | 905,358 | 7,354,902 | 1,069,374 | 8,653,571 |
| Marl, calcareous | do | [1] | [1] | 510 | 525 |
| Mineral paints (zinc and lead pigments) | do | [1 6] | [1 6] | [1 6] | [1 6] |
| Mineral waters | gallons sold | [9] | [9] | [9] | [9] |
| Natural gas | M cubic feet | 46,994,000 | 22,153,000 | 42,783,000 | 19,967,000 |
| Natural gasoline | gallons | 6,991,000 | 436,000 | 7,704,000 | 460,000 |
| Peat | short tons | 4,793 | 28,684 | 3,160 | 26,900 |
| Petroleum | barrels | 3,847,000 | 6,090,000 | 3,559,000 | 5,820,000 |
| Rubbing stones, scythestones, and whetstones | short tons | 170 | 21,736 | 320 | 33,706 |
| Salt | do | 1,633,056 | 2,545,027 | 1,733,875 | 2,625,644 |
| Sand and gravel | do | 8,250,474 | 5,614,671 | 9,198,577 | 6,607,136 |
| Sand and sandstone (finely ground) | do | 46,314 | 339,211 | 37,935 | 296,649 |
| Sand-lime brick | thousands | [1 3] | [1 3] | | |
| Silica (quartz) | short tons | [1] | [1] | [1] | [1] |
| Stone | do | [10] 9,007,420 | [10] 8,005,576 | 10,306,140 | 9,426,808 |
| Sulfuric acid [11] | do | [1 6] | [1 6] | [1 6] | [1 6] |
| Miscellaneous [12] | | | 4,765,413 | | 2,618,287 |
| Total value, eliminating duplications | | | 122,684,043 | | 131,025,104 |

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] According to National Bituminous Coal Commission.
[5] Value is estimated from various sources and includes selling expenses.
[6] Value not included in total value for State.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] No canvass.
[10] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[11] From zinc-roasting operation.
[12] Includes minerals indicated by "1", "2", and "10" above.

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*Mineral production of Oklahoma, 1936–37*

| Product | | 1936 | | 1937 | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| Asphalt (native) | short tons | [1] | [1] | [1] | [1] |
| Cement | barrels | [1] | [1] | [1] | [1] |
| Chats | short tons | 1,134,500 | $181,000 | 3,991,700 | $410,675 |
| Clay: | | | | | |
| Products (other than pottery and refractories) | | | [1 2] | | [2] 583,334 |
| Raw (sold by producers) | short tons | 4,361 | 53,548 | [1] | [1] |
| Coal | do | [3] 1,540,303 | [3] 3,500,000 | [3] 1,600,295 | [4] 3,841,000 |
| Gypsum | do | [5] 156,545 | [1 6] | [6] 159,639 | [6] 266,091 |
| Lead | do | 25,427 | 2,339,284 | 29,840 | 3,521,120 |
| Mineral waters | gallons sold | [7] | [7] | [7] | [7] |
| Natural gas | M cubic feet | 280,481,000 | 28,847,000 | 296,260,000 | 32,039,000 |
| Natural gasoline | gallons | 418,591,000 | 17,516,000 | 492,290,000 | 20,272,000 |
| Ores (crude), etc.: | | | | | |
| Zinc | short tons | 6,132,600 | [8] | 6,644,400 | [8] |
| Zinc-lead | do | 2,953,000 | [8] | 3,787,600 | [8] |
| Petroleum | barrels | 206,555,000 | 232,100,000 | 228,839,000 | 283,500,000 |
| Pumice | short tons | [1] | [1] | [1] | [1] |
| Salt | do | [1] | [1] | [1] | [1] |
| Sand and gravel | do | 1,338,362 | 514,370 | 934,499 | 414,495 |
| Stone | do | 1,213,570 | 1,131,536 | 1,098,790 | 1,149,624 |
| Sulfuric acid [9] | do | [1 10] | [1 10] | [1 10] | [1 10] |
| Tripoli | do | [1] | [1] | [1] | [1] |
| Zinc | do | 129,175 | 12,917,500 | 135,696 | 17,640,480 |
| Miscellaneous [11] | | | 6,563,603 | | 4,338,213 |
| Total value, eliminating duplications | | | 305,191,649 | | 367,444,222 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[6] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] From zinc smelting.
[10] Value not included in total value for State.
[11] Includes minerals indicated by "1" above.

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*Mineral production of Oregon, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement.....barrels | [1] | [1] | [1] | [1] |
| Chromite.....long tons | | | 288 | $880 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $411,238 | | [2] 430,884 |
| Raw (sold by producers).....short tons | [1] | [1] | [1] | [1] |
| Coal.....do | [1 2] | [1 2] | [1 2] | [1 4] |
| Copper.....pounds | 574,000 | 52,808 | 820,000 | 99,220 |
| Diatomite.....short tons | [1] | [1] | [1] | [1] |
| Gems and precious stones | | [5] | | [5] |
| Gold.....troy ounces | 60,753 | 2,126,355 | 52,662 | 1,843,170 |
| Lead.....short tons | 79 | 7,268 | 109 | 12,862 |
| Lime.....do | [1] | [1] | [1] | [1] |
| Mercury.....flasks (76 pounds) | 4,126 | 329,750 | 4,264 | 384,527 |
| Mineral waters.....gallons sold | [5] | [5] | [5] | [5] |
| Ores (crude), etc.: | | | | |
| Copper.....short tons | 1,002 | [6] | 2,796 | [6] |
| Dry and siliceous (gold and silver).....do | 135,336 | [6] | 74,401 | [6] |
| Lead.....do | | | 3 | [6] |
| Lead-copper.....do | | | 30 | [6] |
| Platinum and allied metals.....troy ounces | 68 | 3,228 | 43 | 2,452 |
| Pumice.....short tons | | | [1] | [1] |
| Sand and gravel.....do | 2,315,468 | 881,687 | 2,490,872 | 1,074,907 |
| Silver.....troy ounces | 85,061 | 65,880 | 60,564 | 46,846 |
| Stone.....short tons | 2,463,910 | 1,977,606 | [7] 2,010,490 | [7] 1,442,916 |
| Zinc.....do | 61 | 6,100 | 24 | 3,120 |
| Miscellaneous [8] | | 1,219,055 | | 1,267,926 |
| Total value, eliminating duplications | | 7,080,975 | | 6,609,710 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of granite, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

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*Mineral production of Pennsylvania, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | [1] 22,527,491 | [1] $33,235,017 | [1] 22,952,603 | [1] $31,917,831 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] 10,305,064 | | [2] 11,713,891 |
| Raw (sold by producers)—short tons | 818,630 | 1,989,823 | 875,869 | 2,245,001 |
| Coal: | | | | |
| Anthracite—do | 54,579,535 | 227,003,538 | 51,856,433 | 197,598,849 |
| Bituminous—do | [3] 109,887,470 | [3] 207,548,000 | [3] 111,002,289 | [4] 228,665,000 |
| Coke—do | 13,784,110 | [5] 54,209,459 | 16,260,310 | [5] 65,841,452 |
| Copper [6]—pounds | (7) | (7) | (7) | (7) |
| Feldspar (crude)—long tons | 144 | 828 | (7) | (7) |
| Ferro-alloys—do | 336,889 | [5] 30,465,371 | 428,582 | [5] 42,548,365 |
| Gems and precious stones | | (8) | | (8) |
| Gold [6]—troy ounces | 890 | 31,150 | 1,348 | 47,180 |
| Iron: | | | | |
| Ore— | | | | |
| Sold to furnaces—long tons | 1,104,454 | 2,208,908 | (7) | (7) |
| Sold for paint—do | (7) | (7) | (7) | (7) |
| Pig—do | 9,379,615 | [5] 176,552,170 | 11,036,467 | [5] 239,838,942 |
| Lime—short tons | 661,464 | 4,644,027 | 692,935 | 5,117,733 |
| Mineral paints (zinc and lead pigments)—do | ([5] 7) | ([5] 7) | ([5] 7) | ([5] 7) |
| Mineral waters—gallons sold | (8) | (8) | (8) | (8) |
| Natural gas—M cubic feet | 110,362,000 | 42,874,000 | 115,928,000 | 41,842,000 |
| Natural gasoline—gallons | 14,267,000 | 722,000 | 13,940,000 | 701,000 |
| Peat—short tons | (7) | (7) | (7) | (7) |
| Petroleum—barrels | 17,070,000 | 41,450,000 | 19,189,000 | 49,300,000 |
| Sand and gravel—short tons | 6,241,404 | 5,814,440 | 7,715,962 | 7,587,013 |
| Sand and sandstone (finely ground)—do | (7) | (7) | (7) | (7) |
| Sand-lime brick—thousands | | | ([3] 7) | ([3] 7) |
| Silver [6]—troy ounces | 8,118 | 6,287 | 9,497 | 7,346 |
| Slate | | 2,900,013 | | 2,735,744 |
| Stone—short tons | [9] 15,814,260 | [9] 17,900,502 | 16,091,160 | 17,251,160 |
| Sulfuric acid (60° Baumé) [10]—do | 233,431 | [5] 2,075,202 | 263,341 | [5] 2,456,972 |
| Talc—do | (7) | (7) | (7) | (7) |
| Tripoli (rottenstone)—do | 150 | 4,500 | 200 | 4,800 |
| Miscellaneous [11] | | 8,313,981 | | 11,502,727 |
| Total value, eliminating duplications | | 599,457,486 | | 599,817,364 |

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] Copper, gold, and silver were recovered from pyritiferous magnetite. The quantity of such ore was 1,267,484 short tons in 1936; it is included as iron ore produced. Bureau of Mines not at liberty to publish figures for 1937.
[7] Value included under "Miscellaneous."
[8] No canvass.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] From zinc smelting.
[11] Includes minerals indicated by "1", "7", and "9" above.

*Mineral production of Rhode Island, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay products (other than pottery and refractories) | | ([1] [2]) | | ([1] [2]) |
| Coke—short tons | ([1] [3]) | ([1] [3]) | ([1] [3]) | ([1] [3]) |
| Lime—do | (1) | (1) | (1) | (1) |
| Mineral waters—gallons sold | (4) | (4) | (4) | (4) |
| Sand and gravel—short tons | 275,275 | $143,457 | 370,614 | $296,535 |
| Stone—do | [5] 176,450 | [5] 596,651 | [5] 113,990 | [5] 477,729 |
| Miscellaneous [6] | | 1,741,120 | | 1,492,693 |
| Total value, eliminating duplications | | 929,103 | | 862,710 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of limestone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.



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*Mineral production of South Carolina, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1] $1,127,892 | | [1] $1,185,606 |
| Raw (sold by producers)—short tons | 128,464 | 968,097 | 129,405 | 1,056,696 |
| Copper—pounds | | | 1,500 | 182 |
| Gold—troy ounces | 287 | 10,059 | 2,483 | 86,890 |
| Lime—short tons | | | [2] | [2] |
| Mica: | | | | |
| Scrap—do | [3] | [3] | [3] | [3] |
| Sheet—pounds | [3] | [3] | [3] | [3] |
| Mineral waters—gallons sold | [3] | [3] | [3] | [3] |
| Ore (dry and siliceous) (gold and silver)—short tons | 12,535 | [4] | 21,585 | [4] |
| Sand and gravel—do | 423,615 | 241,463 | 381,185 | 213,488 |
| Silver—troy ounces | 50 | 39 | 624 | 483 |
| Stone—short tons | 637,510 | 1,084,485 | 936,880 | 1,462,738 |
| Tin (metallic equivalent)—pounds | | | 90 | [3] |
| Miscellaneous [5] | | 627 | | 16,242 |
| Total value, eliminating duplications | | 3,432,662 | | 4,022,325 |

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] Includes minerals indicated by "[2]" above.

*Mineral production of South Dakota, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [1 2] | | [1 2] |
| Raw (sold by producers)—short tons | 19,247 | $129,087 | [1] | [1] |
| Coal—do | 41,331 | 55,000 | 46,979 | $63,000 |
| Feldspar (crude)—long tons | 32,144 | 103,671 | 41,392 | 158,976 |
| Gems and precious stones | | [3] | | [3] |
| Gold—troy ounces | 586,353 | 20,522,369 | 581,544 | 20,354,040 |
| Gypsum—short tons | [1 4] | [1 4] | [1 5] | [1 5] |
| Lime—do | [1] | [1] | [1] | [1] |
| Lithium minerals—do | 1,241 | 34,273 | 1,357 | 36,206 |
| Mica, scrap—do | [1] | [1] | [1] | [1] |
| Mineral waters—gallons sold | [3] | [3] | [3] | [3] |
| Natural gas—M cubic feet | 9,000 | 3,000 | 10,000 | 3,000 |
| Ores (crude), etc.: | | | | |
| Dry and siliceous (gold and silver)—short tons | 1,549,146 | [6] | 1,597,178 | [6] |
| Sand and gravel—do | 3,325,490 | 746,711 | 3,845,432 | 612,552 |
| Sand-lime brick—thousands | [1 3] | [1 4] | [1 2] | [1 3] |
| Silver—troy ounces | 144,448 | 111,875 | 139,638 | 108,010 |
| Stone—short tons | 259,130 | 693,496 | [7] 407,270 | [7] 982,906 |
| Tantalum ore (columbo-tantalite)—pounds | | | 13,376 | 11,307 |
| Tin (metallic equivalent)—short tons | [8] | [1] | 1 | 1,000 |
| Miscellaneous [9] | | 822,138 | | 1,141,876 |
| Total value, eliminating duplications | | 23,221,620 | | 23,472,873 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[5] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of dimension sandstone, value for which is included under "Miscellaneous."
[8] 60 pounds.
[9] Includes minerals indicated by "[1]" and "[7]" above.

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*Mineral production of Tennessee, 1936–37*

| Product | | 1936 | | 1937 | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| Aluminum | pounds | (1 2) | (1 2) | (1 2) | (1 2) |
| Barite | short tons | (1) | (1) | (1) | (1) |
| Cement | barrels | 3,035,406 | $4,741,701 | 3,013,817 | $4,683,717 |
| Clay: | | | | | |
| Products (other than pottery and refractories) | | | 3 1,582,216 | | 3 1,873,644 |
| Raw (sold by producers) | short tons | 46,573 | 281,203 | 68,499 | 437,345 |
| Coal | do | 4 5,108,195 | 4 9,460,000 | 4 5,212,471 | 5 10,373,000 |
| Coke | do | 86,872 | 3 397,370 | 104,433 | 3 519,077 |
| Copper | pounds | (1) | (1) | (1) | (1) |
| Ferro-alloys | long tons | 22,159 | 3 1,538,326 | 24,068 | 3 1,669,779 |
| Fuller's earth | short tons | | | (1) | (1) |
| Gold | troy ounces | 410 | 14,350 | 263 | 9,205 |
| Iron: | | | | | |
| Ore | long tons | 27,617 | 73,720 | 28,359 | 89,761 |
| Pig | do | (1 2) | (1 2) | (1 2) | (1 2) |
| Sinter from copper sulfide ore | do | (1) | (1) | (1) | (1) |
| Lead | short tons | (1) | (1) | (1) | (1) |
| Lime | do | 168,121 | 958,407 | 157,440 | 909,839 |
| Manganese ore | long tons | 3,539 | 51,878 | 3,575 | 99,055 |
| Manganiferous ore | do | 104 | 314 | 902 | 6,475 |
| Mineral waters | gallons sold | (6) | (6) | (6) | (6) |
| Natural gas | M cubic feet | 84,000 | 28,000 | 17,000 | 6,000 |
| Ores (crude), etc.: | | | | | |
| Copper | short tons | 662,783 | (7) | 705,000 | (7) |
| Zinc | do | 831,833 | (7) | 975,956 | (7) |
| Zinc-lead | do | 18,000 | (7) | 11,300 | (7) |
| Petroleum | barrels | 20,000 | 20,000 | 35,000 | 35,000 |
| Phosphate rock | long tons | 641,599 | 2,580,432 | (1) | (1) |
| Pyrites | do | (1) | (1) | (1) | (1) |
| Sand and gravel | short tons | 2,243,283 | 1,549,660 | 2,366,646 | 1,458,543 |
| Silica (quartz) | do | (1) | (1) | (1) | (1) |
| Silver | troy ounces | 50,330 | 38,980 | 49,057 | 37,946 |
| Slate | | | (1) | | (1) |
| Stone | short tons | 8 2,840,980 | 8 4,067,227 | 8 2,720,750 | 8 3,979,159 |
| Sulfuric acid 9 | do | (1 2) | (1 2) | (1 2) | (1 2) |
| Tripoli | do | | | (1) | (1) |
| Zinc | do | (1) | (1) | (1) | (1) |
| Miscellaneous 10 | | | 18,952,735 | | 29,805,470 |
| Total value, eliminating duplications | | | 31,121,865 | | 34,893,847 |

1 Value included under "Miscellaneous."
2 Value not included in total value for State.
3 Figures obtained through cooperation with Bureau of the Census.
4 According to National Bituminous Coal Commission.
5 Value is estimated from various sources and includes selling expenses.
6 No canvass.
7 Not valued as ore; value of recoverable metal content included under the metals.
8 Exclusive of granite in 1936 and of crushed sandstone in 1937, value for which is included under "Miscellaneous."
9 From copper smelting.
10 Includes minerals indicated by "1" and "9" above.

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*Mineral production of Texas, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asphalt (native)—short tons | 94,560 | $281,969 | 96,671 | $300,531 |
| Barite—do | | | [1] | [1] |
| Cement—barrels | 5,853,609 | 10,076,934 | 6,687,719 | 11,488,866 |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] 2,789,010 | | [2] 3,242,832 |
| Raw (sold by producers)—short tons | 29,041 | 211,287 | 51,486 | 347,244 |
| Coal: | | | | |
| Bituminous—do | [3] 40,298 | [3] 105,000 | [3] 44,060 | [4] 122,000 |
| Lignite—do | 802,326 | 624,000 | 866,292 | 683,000 |
| Copper—pounds | 53,000 | 4,876 | 320,000 | 38,720 |
| Fuller's earth—short tons | 46,855 | 462,656 | 49,500 | 473,408 |
| Gems and precious stones | | [5] | | [5] |
| Gold—troy ounces | 613 | 21,455 | 562 | 19,670 |
| Graphite, crystalline—pounds | | | [1] | [1] |
| Gypsum—short tons | [6] 257,773 | [6] 2,931,741 | [7] 280,807 | [7] 313,563 |
| Helium—cubic feet | [1 8] | [1 8] | [1 8] | [1 8] |
| Lead—short tons | 468 | 43,010 | 395 | 46,610 |
| Lime—do | 51,281 | 470,510 | 49,135 | 440,069 |
| Manganese ore—long tons | | | 38 | 220 |
| Mercury—flasks (76 pounds) | [1] | [1] | [1] | [1] |
| Mineral waters—gallons sold | [5] | [5] | [5] | [5] |
| Natural gas—M cubic feet | 734,561,000 | 113,929,000 | 854,561,000 | 132,166,000 |
| Natural gasoline—gallons | 520,547,000 | 19,670,000 | 615,281,000 | 24,329,000 |
| Ores (crude), etc.: | | | | |
| Copper—short tons | | | 3,949 | [9] |
| Dry and siliceous (gold and silver)—do | 104,935 | [9] | 116,153 | [9] |
| Lead—do | 55 | [9] | | |
| Lead-copper—do | | | 43 | [9] |
| Petroleum—barrels | 427,411,000 | 449,400,000 | 510,318,000 | 594,500,000 |
| Salt—short tons | 316,006 | 615,815 | 364,780 | 623,037 |
| Sand and gravel—do | 6,425,681 | 3,929,265 | 7,186,717 | 4,058,566 |
| Sand-lime brick—thousands | [1 8] | [1 8] | | |
| Silver—troy ounces | 1,361,459 | 1,054,450 | 1,325,660 | 1,025,398 |
| Sodium sulfate (natural)—short tons | [1] | [1] | [1] | [1] |
| Stone—do | 2,048,360 | 2,323,715 | [10] 2,149,320 | [10] 2,218,643 |
| Sulfur—long tons | 1,630,719 | 29,352,944 | 2,030,315 | 36,545,670 |
| Miscellaneous [11] | | 345,851 | | 287,558 |
| Total value, eliminating duplications | | 638,643,488 | | 813,270,605 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] For details of production in fiscal years see chapters on Helium.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of marble, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "1" and "10" above.

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*Mineral production of Utah, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Arsenious oxide ..... short tons | (1) | (1) | (1) | (1) |
| Asphalt (native) ..... do | 33,731 | $840,103 | 38,171 | $983,628 |
| Bitumen, natural sulfonated ..... do | | | (1) | (1) |
| Cement ..... barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] 567,642 | | [2] 619,950 |
| Raw (sold by producers) ..... short tons | (1) | (1) | (1) | (1) |
| Coal ..... do | [3] 3,246,565 | [3] 6,619,000 | [3] 3,809,476 | [4] 8,648,000 |
| Coke ..... do | 129,963 | ([5]) | 156,316 | ([5]) |
| Copper ..... pounds | 252,434,000 | 23,223,928 | 411,988,000 | 49,850,548 |
| Diatomite ..... short tons | | | 150 | 1,500 |
| Fluorspar ..... do | 700 | (1) | 431 | (1) |
| Gems and precious stones | | ([6]) | | ([6]) |
| Gold ..... troy ounces | 223,444 | 7,820,540 | 322,759 | 11,296,565 |
| Gypsum ..... short tons | [7] 40,275 | [7] 266,854 | [8] 46,197 | [8] 46,197 |
| Iron: | | | | |
| Ore— | | | | |
| Sold to furnaces ..... long tons | 153,923 | 375,475 | 188,794 | (1) |
| Sold for paint ..... do | 268 | (1) | | |
| Pig ..... do | ([5]) | ([5]) | ([5]) | ([5]) |
| Lead ..... short tons | 69,886 | 6,429,512 | 89,458 | 10,556,044 |
| Lime ..... do | 30,986 | 272,431 | 46,670 | 319,517 |
| Manganese ore ..... long tons | 1,635 | (1) | 32 | 297 |
| Manganiferous ore ..... do | 2,974 | 19,931 | 3,436 | 25,771 |
| Mercury ..... flasks (76 pounds) | 25 | 1,998 | | |
| Mica, scrap ..... short tons | | | (1) | (1) |
| Molybdenum ..... pounds | (1) | (1) | 4,804,002 | (1) |
| Natural gas ..... M cubic feet | 92,000 | 19,000 | 2,366,000 | 471,000 |
| Natural gasoline ..... gallons | | | 367,000 | 19,000 |
| Ores (crude), etc.: | | | | |
| Copper ..... short tons | 13,774,589 | ([9]) | 23,197,017 | ([9]) |
| Dry and siliceous (gold and silver) ..... do | 572,821 | ([9]) | 485,152 | ([9]) |
| Lead ..... do | 88,080 | ([9]) | 152,691 | ([9]) |
| Zinc ..... do | | | 173 | ([9]) |
| Zinc-lead ..... do | 562,402 | ([9]) | 743,242 | ([9]) |
| Petroleum ..... barrels | 3,000 | 5,000 | 2,000 | 3,000 |
| Potassium salts ..... short tons | (1) | (1) | (1) | (1) |
| Salt ..... do | 56,480 | 168,706 | 69,696 | 205,328 |
| Sand and gravel ..... do | 2,267,808 | 1,352,296 | 2,345,451 | 1,158,387 |
| Silver ..... troy ounces | 9,997,645 | 7,743,176 | 12,869,117 | 9,954,262 |
| Stone ..... short tons | 422,230 | 230,067 | 453,540 | 315,985 |
| Sulfur ..... long tons | (1) | (1) | (1) | (1) |
| Sulfuric acid [10] ..... short tons | ([5]) | ([5]) | ([5]) | ([5]) |
| Tungsten ore (60-percent concentrates) ..... do | | | 24 | (1) |
| Uranium ores ..... do | (1) | (1) | (1) | (1) |
| Zinc ..... do | 36,192 | 3,619,200 | 48,001 | 6,240,130 |
| Miscellaneous [11] | | 4,390,617 | | 8,186,541 |
| Total value, eliminating duplications | | 61,209,302 | | 105,652,422 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] From copper smelting.
[11] Includes minerals indicated by "1" above.

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*Mineral production of Vermont, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Asbestos short tons | [1] | [1] | [1] | [1] |
| Clay products (other than pottery and refractories) | | [1 2] | | [1 2] |
| Lime short tons | 42,505 | $278,591 | 56,585 | $388,885 |
| Mineral waters gallons sold | [3] | [3] | [3] | [3] |
| Sand and gravel short tons | [1] | [1] | 636,710 | 306,892 |
| Slate | | 1,265,608 | | 1,431,798 |
| Stone short tons | [4] 266,130 | [4] 3,637,838 | [4] 194,770 | [4] 4,215,766 |
| Talc do | 45,746 | 410,045 | 41,118 | 384,474 |
| Miscellaneous [5] | | 633,314 | | 314,732 |
| Total value, eliminating duplications | | 6,225,396 | | 7,042,547 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Exclusive of sandstone, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "1" and "4" above.

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*Mineral production of Virginia, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Barite—short tons | [1] | [1] | [1] | [1] |
| Cement—barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $1,984,356 | | [2] $2,544,596 |
| Raw (sold by producers)—short tons | [1] | [1] | [1] | [1] |
| Coal—do | [3] 11,661,636 | [3] 20,278,000 | [3] 13,795,239 | [4] 27,177,000 |
| Coke—do | 191,331 | [5] 811,894 | 240,425 | [5] 1,180,800 |
| Copper—pounds | | | 1,000 | 121 |
| Feldspar (crude)—long tons | 20,459 | 114,807 | 22,175 | 125,396 |
| Ferro-alloys—do | [1 5] | [1 5] | [1 5] | [1 5] |
| Gold—troy ounces | 909 | 31,814 | 1,396 | 48,863 |
| Gypsum—short tons | [1 6] | [1 6] | [1 7] | [1 7] |
| Iron: | | | | |
| Ore—long tons | 1,206 | 5,796 | 518 | [1] |
| Pig—do | [1 5] | [1 5] | [1 5] | [1 5] |
| Kyanite—short tons | [8] | [8] | [8] | [8] |
| Lead—do | [1] | [1] | [1] | [1] |
| Lime—do | 174,484 | 1,104,982 | 192,493 | 1,248,479 |
| Manganese ore—long tons | 1,361 | 20,772 | 2,265 | 38,561 |
| Manganiferous ore—do | 874 | 6,398 | 1,170 | 9,663 |
| Marl, calcareous—short tons | 6,090 | 6,874 | [1] | [1] |
| Mica: | | | | |
| Scrap—do | [1] | [1] | [1] | [1] |
| Sheet—pounds | [1] | [1] | [1] | [1] |
| Millstones | | 5,151 | | [1] |
| Mineral waters—gallons sold | [9] | [9] | [9] | [9] |
| Ores (crude), etc.: | | | | |
| Dry and siliceous (gold and silver)—short tons | 6,196 | [10] | 10,169 | [10] |
| Zinc-lead—do | 485,634 | [10] | 577,300 | [10] |
| Phosphate rock—long tons | [1] | [1] | [1] | [1] |
| Pyrites—do | [1] | [1] | [1] | [1] |
| Salt—short tons | [1] | [1] | [1] | [1] |
| Sand and gravel—do | 2,735,972 | 1,767,268 | 2,398,462 | 1,753,865 |
| Sand and sandstone (finely ground)—do | [1] | [1] | [1] | [1] |
| Silica (quartz)—do | | | 369 | 1,063 |
| Silver—troy ounces | 96 | 75 | 111 | 86 |
| Slate | | [11] 259,921 | | 355,467 |
| Stone [12]—short tons | [12] 4,488,760 | [12] 4,560,554 | [12] 5,061,660 | [12] 5,399,137 |
| Talc and ground soapstone [12]—do | [1] | [1] | [1] | [1] |
| Titanium minerals: | | | | |
| Ilmenite—do | [1] | [1] | [1] | [1] |
| Rutile—do | [1] | [1] | [1] | [1] |
| Zinc—do | [1] | [1] | [1] | [1] |
| Miscellaneous [14] | | 10,162,102 | | 11,137,832 |
| Total value, eliminating duplications | | 37,295,168 | | 46,019,085 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] Figures not available.
[9] No canvass.
[10] Not valued as ore; value of recoverable metal content included under the metals.
[11] Exclusive of granules, etc., value for which is included under "Miscellaneous."
[12] Soapstone used as dimension stone included in figures for stone.
[13] Exclusive of marble, value for which is included under "Miscellaneous."
[14] Includes minerals indicated by "1," "11," and "12" above.

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*Mineral production of Washington, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Antimony ore—short tons | [1] | [1] | [1] | [1] |
| Cement—barrels | [1] | [1] | [1] | [1] |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $986,884 | | [2] $1,028,804 |
| Raw (sold by producers)—short tons | 43,968 | 104,490 | 49,858 | 91,279 |
| Coal—do | [2] 1,812,104 | [3] 5,504,000 | [2] 2,001,449 | [4] 6,325,000 |
| Coke—do | 28,680 | [5] 172,368 | 14,656 | [5] 87,936 |
| Copper—pounds | 204,000 | 18,768 | 128,000 | 15,488 |
| Diatomite—short tons | 880 | 10,579 | 1,932 | 32,803 |
| Gold—troy ounces | 12,217 | 427,609 | 36,310 | 1,270,850 |
| Iron ore—long tons | 9,082 | 36,361 | 10,010 | 32,859 |
| Lead—short tons | 840 | 77,280 | 2,830 | 333,940 |
| Lime—do | 36,638 | 340,724 | 65,272 | 647,692 |
| Magnesite—do | [1] | [1] | [1] | [1] |
| Magnesium sulfate (natural)—pounds | [1] | [1] | [1] | [1] |
| Mercury—flasks (76 pounds) | [1] | [1] | [1] | [1] |
| Mineral waters—gallons sold | [6] | [6] | [6] | [6] |
| Natural gas—M cubic feet | 141,000 | 99,000 | 143,000 | 100,000 |
| Olivine—short tons | [7] | [7] | [7] | [7] |
| Ores (crude), etc.: | | | | |
| Copper—do | 11,993 | [8] | 6,631 | [8] |
| Dry and siliceous (gold and silver)—do | 45,167 | [8] | 181,604 | [8] |
| Lead—do | 106 | [8] | 445 | [8] |
| Zinc-lead—do | 76,169 | [8] | 106,146 | [8] |
| Peat—do | 1,052 | 14,595 | [1] | [1] |
| Pulpstones—do | [1] | [1] | [1] | [1] |
| Sand and gravel—do | 8,970,849 | 5,942,080 | 9,376,644 | 6,818,154 |
| Sand-lime brick—thousands | [1 2] | [1 2] | [1 2] | [1 2] |
| Silver—troy ounces | 66,900 | 51,814 | 126,304 | 97,696 |
| Stone—short tons | [9] 2,321,710 | [9] 2,279,405 | 2,027,420 | 1,909,604 |
| Talc—do | 462 | 1,805 | 406 | 6,754 |
| Tungsten ore (60-percent concentrates)—do | 48 | 36,294 | 64 | [1] |
| Zinc—do | 4,403 | 440,300 | 4,116 | 535,080 |
| Miscellaneous [10] | | 6,549,468 | | 7,412,254 |
| Total value, eliminating duplications | | 22,921,456 | | 26,658,257 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Figures not available.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1" and "9" above.

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*Mineral production of West Virginia, 1936–37*

| Product | | 1936 | | 1937 | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| Bromine | pounds | 636,290 | $97,235 | 816,375 | $132,494 |
| Calcium chloride | short tons | 12,558 | 71,045 | 16,681 | 78,754 |
| Cement | barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | | |
| Products (other than pottery and refractories) | | | [2] 2,168,821 | | [2] 2,745,183 |
| Raw (sold by producers) | short tons | 55,767 | 99,709 | 48,619 | 94,413 |
| Coal | do | [3] 117,925,706 | [3] 193,443,000 | [3] 118,646,343 | [4] 223,055,000 |
| Coke | do | 1,933,441 | [5] 5,997,699 | 2,097,380 | [5] 7,054,186 |
| Ferro-alloys | long tons | (1 5) | (1 5) | (1 5) | (1 5) |
| Grindstones and pulpstones | short tons | 2,504 | 157,945 | 3,241 | 217,929 |
| Iron, pig | long tons | 669,208 | (1 5) | 685,086 | (1 5) |
| Lime | short tons | 253,339 | 1,601,213 | 250,205 | 1,617,040 |
| Magnesium salts (natural) | pounds | | | (1) | (1) |
| Manganese ore | long tons | 178 | 3,017 | 1,800 | 36,461 |
| Marl, calcareous | short tons | (1) | (1) | (1) | (1) |
| Mineral waters | gallons sold | (6) | (6) | (6) | (6) |
| Natural gas | M cubic feet | 138,076,000 | 54,788,000 | 149,084,000 | 58,639,000 |
| Natural gasoline | gallons | 44,389,000 | 2,306,000 | 50,379,000 | 2,528,000 |
| Petroleum | barrels | 3,847,000 | 8,200,000 | 3,845,000 | 8,800,000 |
| Salt | short tons | 117,401 | 719,382 | 128,715 | 713,421 |
| Sand and gravel | do | 3,755,022 | 2,794,944 | 2,407,911 | 2,349,356 |
| Sand and sandstone (finely ground) | do | (1) | (1) | (1) | (1) |
| Stone | do | [7] 2,970,700 | [7] 2,624,157 | [7] 3,510,040 | [7] 3,696,556 |
| Sulfuric acid [8] | do | (1 5) | (1 5) | (1 5) | (1 5) |
| Miscellaneous [9] | | | 22,811,425 | | 23,041,891 |
| Total value, eliminating duplications | | | 271,501,941 | | 306,660,947 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Exclusive of basalt in 1936 and of dimension sandstone in 1937, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1" and "7" above.

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*Mineral production of Wisconsin, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay products (other than pottery and refractories) | | [2] $343, 520 | | [2] $557, 152 |
| Coke—short tons | (1 3) | (1 3) | (1 3) | (1 3) |
| Iron ore— | | | | |
| Sold to furnaces—long tons | 918, 935 | 2, 568, 129 | 1, 419, 810 | 4, 473, 942 |
| Sold for paint—do | 326 | (1) | 500 | (1) |
| Lead—short tons | 904 | 83, 168 | 1, 091 | 128, 738 |
| Lime—do | 54, 978 | 470, 964 | 59, 536 | 508, 536 |
| Manganiferous ore—long tons | 405 | 1, 807 | | |
| Marl, calcareous—short tons | 22, 012 | 10, 806 | 9, 460 | 2, 914 |
| Mineral waters—gallons sold | (4) | (4) | (4) | (4) |
| Ores (crude), etc.: | | | | |
| Zinc—short tons | 55, 000 | (5) | 5, 000 | (5) |
| Zinc-lead—do | 229, 800 | (5) | 280, 000 | (5) |
| Pyrites—long tons | (1) | (1) | (1) | (1) |
| Sand and gravel—short tons | 8, 192, 376 | 3, 513, 683 | 7, 531, 031 | 3, 291, 944 |
| Sand and sandstone (finely ground)—do | (1) | (1) | (1) | (1) |
| Sand-lime brick—thousands | (1 2) | (1 2) | (1 2) | (1 2) |
| Stone—short tons | [6] 3, 171, 100 | [6] 3, 967, 452 | 3, 331, 670 | 4, 284, 003 |
| Sulfuric acid [7]—do | (1 3) | (1 3) | (1 3) | (1 3) |
| Zinc—do | 8, 126 | 812, 600 | 6, 938 | 901, 940 |
| Miscellaneous [8] | | 6, 028, 225 | | 6, 189, 627 |
| Total value, eliminating duplications | | 13, 277, 983 | | 15, 228, 024 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of basalt, value for which is included under "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by "1" and "6" above.

*Mineral production of Wyoming, 1936–37*

| Product | 1936 | | 1937 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Cement—barrels | (1) | (1) | (1) | (1) |
| Clay: | | | | |
| Products (other than pottery and refractories) | | [2] $127, 590 | | (1 3) |
| Raw (sold by producers)—short tons | 55, 090 | 520, 852 | 67, 958 | $659, 111 |
| Coal—do | [3] 5, 780, 590 | [3] 11, 200, 000 | [3] 5, 918, 359 | [4] 11, 600, 000 |
| Gold—troy ounces | 1, 964 | 68, 754 | 1, 776 | 62, 160 |
| Gypsum—short tons | (1 5) | (1 5) | (1 6) | (1 6) |
| Iron ore—long tons | 507, 278 | (1) | 707, 907 | (1) |
| Mineral waters—gallons sold | (7) | (7) | (7) | (7) |
| Natural gas—M cubic feet | 29, 322, 000 | 4, 564, 000 | 31, 023, 000 | 4, 997, 000 |
| Natural gasoline—gallons | 33, 894, 000 | 1, 752, 000 | 33, 548, 000 | 1, 718, 000 |
| Ores (crude), etc.: | | | | |
| Dry and siliceous (gold and silver)—short tons | 344 | (5) | 17 | (5) |
| Petroleum—barrels | 14, 582, 000 | 13, 700, 000 | 19, 166, 000 | 18, 860, 000 |
| Potassium salts—short tons | | | (1) | (1) |
| Sand and gravel—do | 2, 046, 271 | 768, 756 | 2, 438, 367 | 886, 901 |
| Silver—troy ounces | 1, 113 | 862 | 203 | 157 |
| Sodium sulfate (natural)—short tons | (1) | (1) | (1) | (1) |
| Stone—do | 332, 360 | 308, 276 | [9] 342, 710 | [9] 287, 957 |
| Tin (metallic equivalent)—do | | | 2 | 2, 000 |
| Vermiculite—do | (1) | (1) | (1) | (1) |
| Miscellaneous [10] | | 1, 487, 171 | | 2, 014, 622 |
| Total value, eliminating duplications | | 34, 498, 261 | | 41, 087, 908 |

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[6] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of basalt, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1" and "9" above.

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# WORLD PRODUCTION OF MINERALS AND ECONOMIC ASPECTS OF INTERNATIONAL MINERAL POLICIES

By J. S. McGrath

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Although political developments during 1938 deserve paramount consideration in any world review of the year, an analysis of the gains and losses in terms of mineral raw materials sustained by certain countries illustrates the relative importance of political or commercial control of adequate mineral resources to the economic well-being of any nation.

Since the world depression reached its lowest level in 1933, policies adopted by many countries, but especially by certain major industrial powers, have been directed toward improvement of their national economic structures through whatever means that objective might be accomplished in the light of constant changes in world conditions. Throughout 1938 determined efforts in this direction on the part of Germany and Italy, for example, to attain approximate economic self-sufficiency conflicted with national economic policies of other industrial nations that are more nearly self-sufficient in their domestic supplies of raw materials.

Economic devices, governmentally inspired and administered, such as foreign exchange controls, quota restrictions, production-consumption controls, export-import license requirements, bilateral trade agreements, and barter trade, adopted by many countries during the past few years were applied in many instances more rigidly and extensively during 1938, especially in Germany, Italy, and Japan.

Although national policies in effect during 1938 in the aforementioned countries may have had a more powerful world-wide influence or significance, certain developments in other countries also directly affected world production of and international trade in large tonnages of a diversified group of essential and in most instances strategic mineral raw materials. A number of examples may be cited. On March 19, 1938, the Mexican Government announced the expropri-



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ation of Mexican properties belonging to American and British companies engaged in the production of petroleum in Mexico on the ground that these concerns had engaged in activities that were damaging to the national economy of Mexico; no satisfactory settlement was reached by the end of the year. The civil strife in Spain that began in July 1936 continued throughout 1938, and while production of and foreign trade in mercury, lead, and iron and copper pyrites, of which Spain is an important producer and exporter, did not cease, the difficulties of shipment were more pronounced during 1938. Disturbed internal conditions in China throughout 1938 affected international trade in tungsten and antimony in a manner somewhat similar to that evident in the Spanish situation.

*Conflicting foreign trade policies evident.*—Changes in economic and political conditions throughout the world during the past few years explain, in part at least, the adoption by certain industrial countries that lack adequate domestic supplies of raw materials of national policies whose objective is maximum self-sufficiency and minimum dependence on foreign countries. Germany and Italy are outstanding examples of countries that have adopted this theory of economic self-preservation. Opposed to and in conflict with this planned and governmental-directed renunciation of free trade is the policy that prevails in other major industrial countries of the world and that is based on the use of comparative cost advantages in the operation of international trade. The latter policy naturally places the countries involved in a position somewhat dependent on one another as regards their national economic welfare. The reciprocal trade program of the United States, as provided for in the Trade Agreements Act of June 12, 1934, and extended for 3 years from March 1, 1937, may be accepted as representing the most constructive policy in operation during 1938 directed toward the solution of problems confronting all nations that rely to any extent on foreign trade as an essential factor in their national economy.

The Central-European situation during 1938, with emphasis on the mineral wealth gained by Germany, Poland, and Hungary at the expense of the former Republics Austria and Czechoslovakia, represents an excellent example of the influence on a country's national economy of the possession or lack of adequate domestic supplies of essential mineral raw materials and, with particular reference to Germany, the world-wide effect of policies, whose expressed objective is economic self-sufficiency.

## GERMANY

*Germany's trade policy.*—Germany is an outstanding example among industrial nations of a country whose domestic economy and industrial progress depend on foreign trade, with maximum exports of manufactured products offsetting essential imports of raw materials. In the absence of adequate foreign credits, Germany has developed a foreign trade system of purchasing required raw materials from countries willing to accept German goods as payment. This barter policy during the past few years has resulted in a shifting of the positions of Germany's foreign customers, and while trade with other major industrial countries has declined trade with other countries that produce certain raw materials and import finished products has improved. This shift in foreign trade, and the extent of Germany's dependence on imported raw materials, may be illustrated by the following examples:

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*Imports of certain deficient minerals into Germany in 1932 and 1938*

| Commodity and country of origin | 1932 | | 1938 | | Increase in 1938, percent |
|---|---|---|---|---|---|
| | Metric tons | Percent of total | Metric tons | Percent of total | |
| Bauxite: | | | | | |
| France | 69,564 | 35 | 92,272 | 8 | |
| Hungary | 68,228 | 34 | 363,256 | 31 | |
| Netherland India | | | 192,668 | 16 | |
| Yugoslavia | 39,831 | 20 | 348,068 | 29 | |
| Other countries | 23,108 | 11 | 188,383 | 16 | |
| | 200,731 | 100 | 1,184,647 | 100 | 490 |
| Chromite: | | | | | |
| British South Africa | 17,942 | 42 | 73,393 | 42 | |
| Turkey | 11,565 | 27 | 52,584 | 30 | |
| Yugoslavia | 2,534 | 6 | 12,693 | 7 | |
| Other countries | 10,612 | 25 | 37,736 | 21 | |
| | 42,653 | 100 | 176,406 | 100 | 314 |
| Copper, rough: | | | | | |
| British South Africa | 25,675 | 19 | 76,500 | 28 | |
| Belgian Congo | 18,145 | 14 | 39,931 | 15 | |
| Belgium | 16,670 | 13 | 5,932 | 2 | |
| Chile | 17,486 | 13 | 40,007 | 15 | |
| United States | 21,356 | 16 | 62,330 | 23 | |
| Yugoslavia | 13,970 | 11 | 7,011 | 2 | |
| Other countries | 17,826 | 14 | 40,689 | 15 | |
| | 131,128 | 100 | 272,400 | 100 | 109 |
| Iron ore: | | | | | |
| Algeria | 146,719 | 4 | 755,454 | 4 | |
| Belgium-Luxemburg | 2,335 | (1) | 1,718,049 | 8 | |
| France | 715,609 | 21 | 5,056,121 | 23 | |
| Newfoundland | 191,156 | 6 | 1,121,515 | 5 | |
| Spain | 460,071 | 13 | 1,082,551 | 5 | |
| Spanish Morocco | | | 724,549 | 3 | |
| Sweden | 1,577,740 | 46 | 8,992,331 | 41 | |
| Other countries | 357,978 | 10 | 2,476,969 | 11 | |
| | 3,451,608 | 100 | 21,927,539 | 100 | 535 |
| Manganese ore: | | | | | |
| Brazil | | | 47,769 | 11 | |
| British India | 5,667 | 5 | 17,226 | 4 | |
| British South Africa | | | 268,044 | 63 | |
| Egypt | 7,601 | 7 | | | |
| U. S. S. R. | 85,338 | 80 | 60,925 | 14 | |
| Other countries | 8,173 | 8 | 31,821 | 8 | |
| | 106,779 | 100 | 425,785 | 100 | 299 |

[1] 0.07 percent.

The general decline in business in many of the minor industrial countries during the past few years has been a factor favorable to Germany in the development of its present foreign trade system. The dependence of certain nonindustrial countries on imports of manufactured products and their ability to furnish certain essential raw materials have resulted in the establishment of a definite barter relation between import and export prices in Germany that cannot be reconciled with prevailing world market prices for the products involved. With declining export proceeds, Germany has been able to maintain its imports of raw materials at a relatively high level through the medium of bilateral trade agreements with numerous countries willing to accept manufactured products in return for raw materials required by German industry. According to the German Institute for Business Research, "The barter relation between export and import prices grew steadily worse during the period from 1932 to the spring of 1937

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but since then, as a result of the world business decline, the relation has become more favorable to Germany."

*Austria's contribution to the mineral wealth of Germany.*—What did Germany gain in mineral wealth that may facilitate its drive toward self-sufficiency when on March 13, 1938, a decree was issued declaring Austria to be a State of Greater Germany? At that time, in consequence of the World War, Austria already had lost many important mining districts to Czechoslovakia, Yugoslavia, Poland, and Italy. Like Germany, Austria had depended largely on its export trade to furnish the means, in terms of cash or foreign credits, for obtaining deficient mineral products. However, unlike Germany, where the opposite attitude is an outstanding feature of the New Plan announced in the autumn of 1934 and the Four-Year Plan inaugurated toward the end of 1936, Austria made no serious effort to replace essential imports by substitute materials of domestic origin or to develop under Government direction low-grade, noncommercial domestic mineral deposits. Austria for some years has produced an exportable surplus of iron ore, magnesite, graphite, and talc. The iron ore production—nearly 2 million tons in 1937—without doubt can be more than doubled. One of the most difficult barriers Germany has to hurdle in its drive toward self-sufficiency is the inability to obtain an adequate supply of iron ore from domestic sources. In 1937 Germany imported 20,620,876 metric tons of iron ore and during 1938, 21,927,539 metric tons; the 1938 figure indicates clearly Germany's dependence on foreign sources of supply, as Austria's output after March 1938 was "of domestic origin." The iron ore reserves of Austria probably represent the most valuable mineral asset acquired by Germany from that country. Not unimportant, however, was the acquisition of Austria's magnesite deposits; the annual output has for years maintained Austria in the position of world's largest producer of this mineral. In 1937 Germany imported 178,756 metric tons of magnesite, all grades, while Austria produced over 400,000 tons of crude magnesite and supplied Germany with less than 40 percent of the latter's total annual imports; obviously Germany should be now self-sufficient, or virtually so, in its domestic magnesite reserves. Moreover, with reference to graphite, Germany apparently has become self-sufficient through acquisition of Austria's resources. In 1937 Germany imported 7,953 metric tons of crude graphite while Austria produced more than 23,000 tons; in 1938 Greater Germany imported only 3,750 tons. Germany's imports of pig iron and ferro-alloys in 1937 were slightly less than Austria's total output, and it may be assumed that these items ultimately will disappear from the tables of essential German imports; imports in 1938 were 109,972 tons.

*Mineral wealth gained by annexation of Sudetenland.*—What economic advantages that involve mineral wealth were gained by Germany through annexation in October 1938 of the Sudeten areas in the Provinces of Bohemia and Moravia, Czechoslovakia? The Czech Republic, which came into existence in October 1918, inherited over four-fifths of the industrial resources of the former Austro-Hungarian Empire, including the lead-silver, iron ore, coal, lignite, and radium mines of Bohemia, the iron ore and oil fields of Slovakia, and the southern tip of the Silesia coal-mining district. The determination of Germany, apparent early in 1938, to acquire at least a portion of Czechoslovakia culminated first in the Munich Agreement of Septem-

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ber 30, 1938, which approved the partition of Czechoslovakia, and then in its final dissolution in March 1939. Before the end of October 1938 a new German-Czech border was defined. The economic advantages to Germany were as yet questionable by the end of the year. The heavy industries, especially the Skoda armament works—the largest in Europe outside of Germany—remained just inside the Czech frontier as of December 31, 1938. However, about 94 percent of the lignite produced annually and about 12 percent of its coal output were lost to Germany by Czechoslovakia. Losses to Poland and Hungary will be summarized later. Germany's acquisition of the lignite and coal deposits in northwest Bohemia has little economic importance, as there was already within Germany a sufficiency of both. Czechoslovak lignite deposits are, however, of much higher grade than is German "brown coal."

In addition to the lignite and coal resources lost by Czechoslovakia during 1938, the State-owned radium mine at Joachimstal, Bohemia, the high-grade china clay deposits, and virtually all the china and porcelain plants of western Bohemia now belong to Germany. In 1937 Germany imported 236,898 tons of china clay, of which 75 percent originated in Czechoslovakia. The total output of Czechoslovakia in 1937 was about 360,000 tons; in 1938 Germany imported only 189,310 tons. It seems probable that this item may likewise disappear from the list of essential German imports.

*German annexation of Czech Provinces of Bohemia and Moravia.*—On March 16, 1939, the Republic of Czechoslovakia lost its identity as an independent State; the Province of Slovakia declared its independence, the Provinces of Bohemia and Moravia were annexed by Germany, and the Province of Ruthenia (Carpatho-Ukraine) was annexed by Hungary. This dissolution of Czechoslovakia added little to Germany's mineral resources, but acquisition of the Skoda armament works at Plzeň and those in Brno represents significant gains to German industry.

The mineral wealth acquired by Germany through annexation of Austria in March 1938, the Sudetenland of Czechoslovakia in October 1938, and the Czech Provinces of Bohemia and Moravia in March 1939 has relatively minor importance in the effort being made to achieve self-sufficiency. The additional territory gained would appear to make more pronounced Germany's deficiencies in the nonferrous metal group and in nonmetals, especially petroleum products.

*Trade agreement with Rumania.*—Soon after the dismemberment of Czechoslovakia, Germany negotiated a trade agreement with Rumania that was signed on March 23, 1939. This agreement is significant because of Germany's dependence on imports of petroleum products and the fact that Rumania ranks about sixth among the petroleum-producing countries of the world. The agreement provides for German-Rumanian collaboration in matters pertaining to economic planning, and from that portion of the text published economic penetration of Rumania by Germany appears inevitable. For example, the agreement stipulates that German-Rumanian companies will be organized to exploit Rumanian resources of petroleum, pyrites, chrome, manganese, and bauxite; German and Rumanian banks will collaborate in financing such mixed enterprises; and Germany will collaborate in the construction and improvement of Rumanian railways, waterways,

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and other public utilities. The agreement is for a 5-year period, and if not repudiated with 1 year's notice it will continue indefinitely.

Reliable but unofficial sources report that the agreement provides for an assignment to Germany of 40 percent of Rumania's exports of petroleum products. Gasoline has been the most important petroleum product exported by Rumania to Germany; should the afore-mentioned report be correct, Germany will have to depend on other foreign sources for only one-third or less of its motor-fuel requirements.

## POLAND

*Mineral wealth gained by partition of Czechoslovakia.*—Although Sudeten territory lost by Czechoslovakia may be considered relatively unimportant to present-day German economy, the comparatively small area of about 500 square miles acquired by Poland represents a gain of paramount importance to Polish national economy. The acquisition by Poland in November 1938 of Trans-Olzan Silesia or the Olza district, a highly industrialized region containing high-grade coking-coal deposits and extensive iron and steel plants, undoubtedly will bring far-reaching benefits to the country. The predominant industries of this area are coal mining; the manufacture of iron, steel, and other metals, chemicals, and clothing; and the preparation of lumber—about 2,800 separate enterprises in all. About 75 percent of the coal and 40 percent of the steel produced formerly by Czechoslovakia came from this area.

Of the various branches of Polish industry that will benefit from the annexation of Trans-Olzan Silesia, coal mining and the iron and steel industry will gain most, the former increasing its annual output by 20 percent on the basis of 1937 figures and the latter by 55 percent in pig iron and 50 percent in steel.

*Coal-mining industry.*—The importance of the coal-mining industry in Trans-Olzan Silesia is based on extensive formations of coking coal. The deposits were the best and richest of the former Austro-Hungarian Empire, and the coking qualities of the coal prompted the establishment of important foundry and metal-manufacturing industries in this area.

The coal deposits occur in the Ostrawa-Karwina region, which forms a part of the extensive Upper Silesia coal basin, portions of which have been within the Republic of Poland since 1919, in Germany, and the remainder herein described in Czechoslovakia. The portion formerly held by Czechoslovakia and annexed by Poland in November 1938 represents one-seventh of the entire basin. The most important coal deposits of this area are centered around Karwina, Lazy, and Orlowa; the average depth of shafts is 600 meters. Coal reserves of Trans-Olzan Silesia are reported to be about 4 billion metric tons compared with 62 billion tons of former Poland; the developed reserves of the Trans-Olzan area are estimated at 250 million tons. During 1937 production in the area acquired by Poland totaled 7,352,000 metric tons as against a total Polish production of 36,000,000 tons in the same year. The coke production in 1937 was 1,156,100 metric tons as against a total Polish production of 2,126,000 tons. All coal mines in the region have modern equipment, and at least two-thirds of the coal mined is extracted by mechanical means. The coal produced in Trans-Olzan Silesia contains between 12,600 to 14,400 B. t. u. per pound and has a 65- to 80-percent yield of coke.

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Various types of coke are produced in the area. Some of the plants producing special foundry coke are especially suitable for steel production, and there is a fuel coke whose quality is said to surpass that produced in Polish Upper Silesia.

*Iron and steel industry.*—Absorption of the extensive iron and steel plants and minor iron ore deposits in Trans-Olzan Silesia are of greater importance to Poland's national economy than the coal deposits acquired. The iron and steel industry of this area is based in part on iron ore deposits in the immediate neighborhood of foundries at Trzyniec. These deposits are chiefly low-grade ores containing about 30 percent iron. Annual output has not exceeded 150,000 metric tons. The industry therefore depends to a large extent on iron ore supplies from the former Province of Slovakia and on high-grade ores imported from Sweden and the Soviet Union. A well-equipped network of railways provides adequate transportation of coal and iron ore shipped from mines to industrial centers in this region.

The largest iron and steel foundry in Trans-Olzan Silesia, that at Trzyniec, is capitalized at $7,800,000, employs 5,500 workmen, and ranks among the largest European steel concerns. Founded in 1839, the plant belongs to a well-known Czechoslovak metallurgical trust, the controlling interest in which is held by the Schneider-Creusot interests of France; the latter concern also has a substantial interest in the large Skoda armament works of Czechoslovakia. This foundry produced approximately one-fourth of former Czechoslovakia's total production of iron and steel. As a member of the International Steel Export Cartel, its annual export quota has amounted to 50,000 metric tons of rolling-mill products equivalent to about 60,000 metric tons of raw steel. Since Poland's export quota as formerly fixed by the cartel was 300,000 metric tons of raw steel per year, it follows that Poland's aggregate steel exports will be increased by about 20 percent.

The Trzyniec foundry operates four blast furnaces in the production of pig iron, with an estimated annual capacity of 530,000 metric tons. Incorporation of the Trzyniec foundry into Poland will raise the country's annual pig iron production to 1,380,000 metric tons, an increase of 55 percent. The significance of this increase is especially pronounced when it is recalled that the Four-Year Plan adopted by Poland in 1937 for expansion of the iron and steel industry did not anticipate an annual production level of 1,300,000 metric tons before 1940.

The Trzyniec foundry operates 12 Martin furnaces for steel production, a Wellman-Seever tip-furnace, and a 300-ton mixer. It is estimated that Poland's production of raw steel for 1938, excluding the Trans-Olzan Silesia output, was about 1,525,000 metric tons, and it is probable that the output of present-day Poland for 1939 will reach 2,275,000 metric tons, an increase of 50 percent. As in the case of pig iron, this increase is the more significant as the Four-Year expansion plan adopted in 1937 provided for an annual production level of 2 million tons in 1940. In addition to pig iron and raw steel, the Trzyniec foundry specializes in rolling-mill products having an estimated annual capacity of 400,000 tons of semimanufactured commodities or 300,000 tons of finished manufactures as against a total annual Polish production of 1 million tons prior to annexation of this area. The bulk of semimanufactured products made at Trzyniec is for-



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warded for processing to a plant that belongs to the same corporation at Bogumin.

The other iron and steel center of Trans-Olzan Silesia is Bogumin, where the Alfred Hahn Co. established a foundry 50 years ago. The controlling interest in the company is said to be held by the Rothschild interests. This foundry employes over 1,000 workmen and operates a large blast furance and four Martin furnaces with an annual capacity of 150,000 metric tons of raw steel. It also operates an extensive pipe plant, whose capacity—900,000 tons annually—exceeds that of all Polish pipe factories.

## HUNGARY

*Czech contribution to mineral wealth of Hungary.*—A new Hungarian-Czech frontier was defined on November 2, 1938. The area then lost by Czechoslovakia—about 4,200 square miles along the southern border of Slovakia and Ruthenia (Carpatho-Ukraine)—is considered less important as a source of mineral raw materials than territories acquired by Germany and Poland. After the World War Czechoslovakia acquired from Hungary iron mines that produced about 725,000 metric tons of ore annually; Hungary's acquisition in November 1938 of Czech territory involves the return to Hungary of mines producing approximately 234,000 metric tons of iron ore annually. Production from these mines has for years been discouraged by the Czech authorities, and it appears certain that output can be increased considerably.

Hungary regained the lignite or brown-coal basins in the former frontier, where it is reported production was allowed to decline when the territory was part of the Czech Republic. As Hungary already had ample reserves of lignite but imported large tonnages of bituminous coal and anthracite, the increase in lignite resources has little importance. Hungary also regained the magnesite deposits of former Czechoslovakia, but the annual output in recent years has been less than 10,000 tons of crude magnesite; therefore, this gain is relatively unimportant. Certain basalt quarries, antimony mines, and kaolin and soapstone deposits, which were in operation but had an output of slight commercial importance, were also regained by Hungary.

Acquisition of the former Czech Province of Ruthenia (Carpatho-Ukraine) in March 1939 adds little to the mineral resources of Hungary. The industrial gains by Hungary through acquisition of former Czech territory are not great. In these areas the former Czechoslovak Government encouraged agriculture but discouraged industrial development, except for minor industries connected with the processing of agricultural products. Before the World War the iron and metal industries in this area employed 15,000 workers, but this number was reduced to 3,000 by 1930. Most other industries experienced the same reduction in employment, and many industrial plants were closed by the Czech authorities.

## ITALY

*General statement relative to conditions during 1938.*—Italy's known mineral resources make it virtually impossible for that nation to become self-sufficient, regardless of Government expenditures on mine development work, subsidies to producers whose production costs

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exceed world market prices, and forced substitution of domestic products for essential imports. During 1938 intensive efforts were made to increase the domestic output of coal, oil, iron ore, copper, and certain other metals, but comparatively little progress was made in this direction. With the exception of bauxite, aluminum, mercury, sulfur, and zinc Italy depends on foreign sources for a large percentage of its mineral requirements.

According to statements in the Italian press during 1938, the country is expected to become independent of coal, oil, and iron ore imports. Toward the end of 1938, the Government erected in Rome an impressive and educational exhibit—"Mostra autarchica del minerale italiana"—of the country's mineral and metal industries, said to have cost $5,000,000. All minerals on display may be found in Italy but not in sufficient tonnages of commercial grades to warrant development or to justify the conclusion that Italy is or can become self-sufficient with regard to domestic resources.

By the end of 1938, Italy was producing 1 percent of the crude oil, 5 percent of the copper, 15 percent of the coal, 25 percent of the iron, 45 percent of the manganese, and 70 percent of the lead consumed in Italy. There is practically no domestic output of nickel, chrome, tungsten, or tin. On the other hand, there is a surplus of mercury, sulfur, bauxite, aluminum, and zinc.

*Financing the program leading toward mineral self-sufficiency.*—National self-sufficiency or autarchy in the mineral industries has been a costly program for Italy, but the expressed purpose is a determination to lessen the dependence of Italy on foreign sources of supply in times of national emergency and to reduce unemployment to a minimum. To avoid depletion of its gold reserve, Italy is making strenuous efforts to increase exports of surplus mineral products and has applied restrictions on imports and uses of several mineral and metal products. The program of national self-sufficiency in minerals is administered by the Azienda Minerali e Metalli Italiana, and the latter's operating expense is borne in part by Italian banks that hold shares in the organization. On December 15, 1938, the Government announced that the program of national self-sufficiency should be effected from national savings through institutions equipped for long- and medium-term operations, principally through the Instituto Mobiliare Italiano. Credit institutions are to allocate a suitable portion of their funds for the purchase of obligations for this purpose and must assist in marketing these obligations among the Italian public. Public and private insurance organizations likewise must cooperate.

As many of the projects for increased mineral production are considered noncommercial, public funds can be obtained only through such a system of forced subscriptions from private savings.

Italy is by far the poorest of the so-called "Great Powers" of Europe in regard to natural resources; nevertheless, the Government is strenuously applying plans for self-sufficiency through stimulated domestic output and increased imports only of essential raw materials which are, in many instances, being stored for emergency use. Throughout 1938 all heavy industries operated at capacity.

*Iron and steel industry.*—The output of Italian iron ore represents about one-fourth of the requirements for the steel industry. Another 10 percent of the iron ore required is derived by treatment of pyrite

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ash in electric furnaces. The remainder of the iron consumed is obtained largely through imports of scrap iron and from domestic scrap.

Application of sanctions by the League of Nations late in 1935 stimulated domestic production of iron ore to replace imports of scrap iron, which in 1935 totaled about 1,000,000 metric tons and in 1937 and 1938 averaged 550,000 tons. Early in 1938 the Government approved the reorganization of the Italian iron and steel industry along such lines as would insure the maximum degree of self-sufficiency as quickly as possible. Efforts are to be made to double the iron ore output by 1940 by increasing annual production of the Elba mines to 600,000 tons, at Cogne in Val d'Aosta to 350,000 tons, the Val d'Aspra mines from 50,000 to 100,000 tons, and the mines of Bergomastre from 50,000 to 100,000 tons; and increase to 250,000 tons a year of the Nurra iron ore deposits in northern Sardinia was also provided for. With these increases, together with the output of the smaller mines and greater use of pyrite ash, it may be possible to supply nearly one-half of Italy's iron requirements from domestic sources by 1940.

The increase in iron ore production during 1938 was less than anticipated, and imports were more than doubled to meet the requirements of the steel industry. Morocco supplied 216,212 tons, Algeria 33,676 tons, and Turkey 33,048 tons. In January 1939 a contract was made with the Franco Government of Spain for 45,000 tons of ore from Bilbao to be delivered by June 1939.

Manganese ore production in 1939 is expected to reach 50,000 tons. Imports in 1937 were 75,384 and 1938, 58,079 tons.

Pig iron output in 1938 increased about 10 percent, but imports of pig iron advanced from 22,185 tons in 1937 to 68,731 in 1938, with Spain supplying 45,504 tons in 1938 compared with only 700 in 1937.

In 1938 authorization was granted to the Societa Italiana Acciaierio Cornigliano, an affiliate of the Ansaldo Co., to erect a new steel plant at Genoa. When this is completed the bulk of the Italian iron and steel industry will be concentrated in three great establishments at Bagnoli, Piombino, and Genoa.

Imports of scrap iron during 1938 were 615,339 tons (the United States supplying 406,867 tons) compared with 545,053 in 1937. A total of 55,235 tons of scrap iron and steel was obtained domestically by demolishing old ships, most of which, however, were purchased abroad. A semi-Government institution is authorized by Royal Decree of June 1938 to purchase and distribute iron and steel scrap required by iron and steel producers. This organization maintains headquarters in Rome, and its capital is made up of contributions by the manufacturers in proportion to the raw steel and iron produced by them during the period July 1, 1936, to June 30, 1937. Imports of pig iron are controlled by the National Consortium for Raw Materials for Iron Foundries of Milan. The sale, distribution, and prices of iron and steel products within Italy are controlled by the new Italian Iron and Steel Union of Milan.

*Nonferrous metal industries.*—Among the nonferrous ores and metals, lead was outstanding in 1938, with a 10-percent increase in production of both ore and metal. Lead imports during the year totaled 8,609 metric tons compared with 10,887 tons in 1937. Germany and Mexico were the principal countries of origin. The Montevecchio mine and

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the lead smelter at San Gavino in Sardinia contributed most in the increase of production.

The 12-percent increase in the production of zinc ore in 1938 was due chiefly to Government subsidy to mining companies. The lead-zinc mines in Sardinia and at Raibl in northern Italy contributed to this increase. Zinc ore exports increased about 5,000 tons in 1938. Although the 1938 output of zinc metal represents a decrease of 10 percent below the 1937 figure, it is expected that the new electrolytic zinc plant at Porto Maghera will provide a decided increase in 1939. Exports of slab zinc in 1937 amounted to 400 tons, but in 1938, 450 tons of the metal were imported. A decree of April 28, 1938, provides for a premium of 1.25 lire for each ton of zinc concentrate exported after January 1, 1938, and for each pound-sterling difference between London quotations for zinc and £19. For each ton of zinc concentrate exported, over and above the 1937 export figure, 1.25 lire per ton also is paid for each pound-sterling difference between London quotations and £23, provided the production of lead ore has increased over that of 1937, which increase must not be less than 10 percent in 1938, 20 percent in 1939, and 30 percent in 1940. These premiums are intended to stimulate the output of lead, not zinc, as there is a surplus of the latter, but because the complex ores run high in zinc, metallic lead production has not been adequate to meet domestic requirements. Both the imports and exports of lead and zinc are subject to license and are controlled by the National Metal Office, Milan. The exportation of zinc and lead is prohibited, except under license, by decree dated December 7, 1937.

Bauxite production increased slightly in 1938, and because of greater domestic consumption exports dropped 55,000 metric tons compared with those in 1937. Of importance in 1938 was the opening of new bauxite deposits at Gargone in southeastern Italy by the Societa di Montecatini.

Aluminum output was increased to 26,000 metric tons in 1938, and an even greater increase is anticipated for 1939, as the alumina and aluminum plants at Porto Maghera, Mori, and Bolzano are being enlarged. At Aurelia, near Civitavecchia, where unsuccessful attempts were made to produce alumina from lucite, the plant is being rebuilt to produce alumina from bauxite and the product will be shipped to the aluminum plant at Borgo Franco in northern Italy. Foreign trade in bauxite and aluminum are subject to license. The domestic market for aluminum is controlled by the S/A Alluminio of Milan.

The output of mercury ore in 1938 increased but production of metallic mercury decreased compared with 1937. The world market for Italian mercury was favorable throughout 1937, when export amounted to 2,172 metric tons, but in 1938 exports dropped to 1,575 tons. The decrease in 1938 was due to reduced purchases by Great Britain and the United States.

Among the nonferrous metals, the lack of an adequate domestic supply of copper is Italy's greatest handicap. Present production is derived from domestic and imported cupriferous pyrite ore. Imports of cupriferous pyrites from Spain during 1938 of 5,000 tons represents a noticeable increase from the 1,000 tons imported in 1937. Metallic copper imported in 1938 amounted to 77,333 tons, a slight increase compared with the imports during 1937.

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Nickel is another metal the domestic supply of which is wholly inadequate to meet Italy's requirements. Considerable exploratory work is being conducted in the Piedmont region, where pyrrhotite veins and masses containing some nickel have been located, and in Sardinia, where extensive quartz veins containing nickel have been developed and a small output reported. Metallic nickel imports of 3,694 tons in 1938 represent an increase above the 2,822 tons imported during 1937, and it is reported that a portion of the imported raw material has been stored for future use.

Although Italy has no commercial source of tin, efforts are being made, at great expense, to develop deposits in the Arbus area, Sardinia, and at Mount Valerio in Tuscany. Metallic tin production of Italy increased from 80 metric tons in 1937 to 320 tons in 1938, but part of this is reported to be metal recovered from scrap. Metallic tin imports increased from 3,639 tons in 1937 to 4,441 tons in 1938, and, as with nickel, it is reported that a considerable portion of the metal has been stored for future use.

During the past few years in the interest of conservation, the Italian Government has regulated imports and domestic consumption of certain mineral and metal products. This policy continued throughout 1938. A royal decree dated June 16, 1938, prohibits (under certain conditions set forth in appropriate regulations) the use of copper, nickel, tin, chrome, cobalt, and their alloys in the manufacture of industrial products wherever substitutes of domestic origin may be utilized. The Government also may prohibit importation of manufactured products made of copper, nickel, tin, chrome, cobalt, and their alloys. The Italian Official Gazette of December 12, 1938, published another decree dated November 28, 1938, which limits the use of copper and its alloys in the manufacture of electric conductors and cables. This decree probably is intended to stimulate the use of aluminum of domestic origin.

*Other minerals.*—Production of crude sulfur in Italy during 1938 increased 33,000 metric tons compared with the preceding year, but exports dropped sharply in 1938. A slight increase in exports of refined sulfur occurred in 1938. Sulfur stocks at the disposal of the Italian Sales Office were greatly increased during 1938. The greatest difficulties faced by the Italian sulfur producers were the increasing competition originating outside of the American-Italian combination and the added competition from Spanish pyrite producers who are shipping increased tonnages of sulfur to Great Britain and France. It is anticipated that sulfur production from coke gas in Germany eventually will reduce imports by that country from Italy. The future outlook for the Italian sulfur industry is not particularly encouraging. All sulfur exports are controlled by the Ital-Zolfi organization in Rome.

There was little change in the statistical position of the Italian pyrite industry during 1938. The estimated output during the year was 926,000 tons, most of which originates from the mines in Tuscany. The net exports during 1938 showed a reduction to 131,912 tons from 271,308 tons in 1937. Pyrite imports are permitted only by license from Istcambi.

The principal coal mines in Italy gradually have been absorbed by the Azienda Carboni Italiana, a Government organization that administers mine development work, production, and marketing. Large expenditures were made in 1938 by this organization on development

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work in the Sulcis coal field of Sardinia and in the Arsa coal field on the Pola Peninsula. Most of the mines have been mechanized and modern washeries built, and it is planned to double the output of these two coal fields by 1940. In 1938 the output of the Arsa field was 866,000 tons and that of the Sulcis field 550,000 tons. In addition to production in these two fields, the anthracite output from the La Thuile mines in Val d'Aosta and the lignite mines near Valdarno in Tuscany must be considered.

Coal imports in 1938 were 11,816,995 tons compared with 12,572,816 tons during 1937. Germany is the principal supplier, and Great Britain and Poland follow in the order named. Assuming that it takes 1⅓ tons of Italian coal to equal 1 ton of imported coal, Italy's domestic production may be estimated to represent about 13 percent of her apparent consumption. Unless the present rate of consumption is materially reduced by increased use of hydroelectric power by railways and industrial plants, it will be some years before Italy can supply from domestic sources the planned 20 percent of her coal requirements. Italy is without domestic sources of coking coal and depends principally on Germany for her requirements of coking coal and coke.

Imports of both coal and coke are controlled by the Italian State Railway Administration in Rome, commonly known as a Government monopoly which acts as the buying agent for importers and serves as distributing agent for domestic dealers and consumers. Dealers and consumers are allotted quotas based on their imports in 1934.

Production of natural crude oil in Italy during 1938 amounted to 13,200 metric tons, or less than 1 percent of the tonnage imported during the year. From the Davoli oil fields in Albania the output for 1938 was estimated at 90,000 tons, two-thirds of which was imported by Italy.

The refinery capacity in Italy nearly suffices to produce most of the output required. With the new refineries of the Azienda Nazionale Idrogenazione Combustibile in operation at Bari and Leghorn, where hydrogenation as well as the cracking process will be applied, an additional 240,000 tons of gasoline may be recovered during 1939. However, instead of obtaining the 300,000 tons of crude oil required by these plants from Albania, about 200,000 tons of this quantity will of necessity have to be imported from elsewhere.

Italian gasoline consumption in 1938 is estimated at 440,000 tons, of which 406,000 tons were furnished by Italian refineries.

The total imports of petroleum products for 1938 is estimated at about 2,500,000 tons. Of Italy's total oil imports, 70 percent enters the Mediterranian via Gibraltar.

All imports of petroleum products are controlled and quotas allotted to importing firms by the Ufficio Speziale per Combustibile Liquidi, an agency that operates under the Ministry of Corporations. This office also regulates the retail price, which at the end of 1938 was about 70 cents a gallon for gasoline.

The A. G. I. P., a Government-financed petroleum company, continued throughout 1938 exploratory drilling for oil at several points along the Po Valley and on the Great Dalac Island in the Red Sea; geological studies were also extended throughout Ethiopia and in Libia near the Egyptian frontier. There were no discoveries of importance, but the existing oil structures are reported to be favorable to oil possibilities.

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On November 9, 1938, the Council of Ministers approved a second Five-Year Plan for oil exploratory work in Italy and its colonies, to be financed by the Government and carried out under the auspices of the A. G. I. P. Late in 1938 negotiations were being conducted between Italy and Mexico leading toward a barter arrangement involving the exchange of Mexican crude oil for merchant tonnage to be built in Italian shipyards.

## ACKNOWLEDGMENTS

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# PART II. METALS

## GOLD AND SILVER

By Chas. W. Henderson and J. P. Dunlop

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Mine production of gold in the United States (Territories included) set a new annual record in 1938, surpassing the former record made in 1915 by 352,336 ounces in quantity and $81,370,691 in value. In the 5 years (1934–38) that have passed since gold was revalued at $35 per fine ounce in terms of United States currency (compared with $20.67+ from 1837 to 1933) the domestic annual output has nearly doubled. Although final figures on the total production of gold in the world in 1938 are not yet available, preliminary data indicate that the world output also was the highest on record, having increased 49 percent since 1933. The principal gold-producing countries in 1938, in order, were the Union of South Africa, U. S. S. R., Canada, and continental United States; these four countries together produced approximately 71 percent of the total world output of gold. Silver production in the United States decreased from 72,128,397 fine ounces in 1937 to 62,873,450 in 1938. The output in 1932, the year before legislation was enacted to raise the price, was only 22,899,865 ounces. Approximately 70 percent of the total world output of silver in 1938 came from four countries—Mexico, United States, Canada, and Peru—listed in order of quantity produced.

### DOMESTIC REFINERY PRODUCTION

The figures in the following table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two Bureaus.

The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the Bureau of Mines directly from the producing mines and tabulated for the mine reports discussed later. The data for the total production and in part for the distribu-



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tion are obtained from records of (1) the unrefined domestic gold and silver deposited in the United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is small.

*Gold and silver produced in the United States, 1934–38, and approximate distribution, by States and Territories, in 1937 and 1938*

[Figures supplied by U. S. Bureau of the Mint]

| State or Territory | Gold [1] | | Silver [2] | |
|---|---|---|---|---|
| | Fine ounces | Value | Fine ounces | Value |
| 1934 | 3,091,183 | $108,191,400 | 32,725,353 | $21,155,784 |
| 1935 | 3,609,283 | 126,324,900 | 45,924,454 | 33,008,201 |
| 1936 | 4,357,394 | 152,508,800 | 63,812,176 | 49,422,530 |
| 1937: | | | | |
| Alabama | 2,483 | 86,900 | 734 | 568 |
| Alaska | 628,800 | 22,008,000 | 656,894 | 508,108 |
| Arizona | 344,060 | 12,042,100 | 9,541,141 | 7,380,073 |
| California | 1,169,491 | 40,932,200 | 2,794,550 | 2,161,584 |
| Colorado | 379,246 | 13,273,600 | 6,286,393 | 4,862,525 |
| Georgia | 563 | 19,700 | 44 | 34 |
| Idaho | 82,811 | 2,898,400 | 19,556,118 | 15,126,657 |
| Illinois | | | 1,236 | 956 |
| Maryland | 1,070 | 37,400 | 30 | 23 |
| Michigan | 51 | 1,800 | 19,022 | 14,714 |
| Missouri | | | 118,080 | 91,335 |
| Montana | 204,903 | 7,171,600 | 11,740,970 | 9,081,640 |
| Nevada | 272,531 | 9,538,600 | 4,722,623 | 3,652,949 |
| New Mexico | 43,354 | 1,517,400 | 1,400,330 | 1,083,155 |
| New York | | | 45,752 | 35,389 |
| North Carolina | 871 | 30,500 | 5,649 | 4,370 |
| Oregon | 53,757 | 1,881,500 | 75,154 | 58,132 |
| Pennsylvania | 1,423 | 49,800 | 10,206 | 7,894 |
| Philippine Islands | 692,363 | 24,232,700 | 642,864 | 497,255 |
| Puerto Rico | 17 | 600 | 1 | 1 |
| South Carolina | 1,957 | 68,500 | 491 | 380 |
| South Dakota | 575,814 | 20,153,500 | 142,063 | 109,886 |
| Tennessee | 663 | 23,200 | 50,065 | 38,724 |
| Texas | 566 | 19,800 | 1,338,393 | 1,035,247 |
| Utah | 311,943 | 10,918,000 | 12,692,203 | 9,817,419 |
| Virginia | 1,149 | 40,200 | 787 | 609 |
| Washington | 32,974 | 1,154,100 | 99,627 | 77,062 |
| Wyoming | 1,680 | 58,800 | 374 | 289 |
| | 4,804,540 | 168,158,900 | 71,941,794 | 55,646,978 |
| 1938: | | | | |
| Alabama | 37 | 1,300 | 3 | 2 |
| Alaska | 659,831 | 23,094,100 | 563,806 | 364,481 |
| Arizona | 307,646 | 10,767,600 | 7,483,213 | 4,837,633 |
| California | 1,317,549 | 46,114,200 | 2,694,270 | 1,741,750 |
| Colorado | 375,317 | 13,136,100 | 7,805,543 | 5,046,008 |
| Georgia | 780 | 27,300 | 63 | 41 |
| Idaho | 98,003 | 3,430,100 | 18,397,204 | 11,892,142 |
| Illinois | | | 92 | 59 |
| Maryland | 857 | 30,000 | 24 | 15 |
| Michigan | | | 106,468 | 68,828 |
| Missouri | | | 169,223 | 109,397 |
| Montana | 188,360 | 6,592,600 | 6,761,582 | 4,371,124 |
| Nevada | 280,009 | 9,800,300 | 4,114,601 | 2,659,944 |
| New Mexico | 41,800 | 1,463,000 | 1,261,996 | 815,836 |
| New York | | | 40,834 | 26,398 |
| North Carolina | 1,977 | 69,200 | 4,985 | 3,223 |
| Oregon | 80,397 | 2,813,900 | 91,761 | 59,320 |
| Pennsylvania | 1,406 | 49,200 | 10,625 | 6,869 |
| Philippine Islands | 844,434 | 29,555,200 | 976,501 | 631,273 |
| Puerto Rico | 9 | 300 | 1 | 1 |
| South Carolina | 11,414 | 399,500 | 2,444 | 1,580 |
| South Dakota | 591,757 | 20,711,500 | 158,164 | 102,247 |
| Tennessee | 380 | 13,300 | 38,918 | 25,159 |
| Texas | 431 | 15,100 | 1,381,110 | 892,839 |
| Utah | 215,414 | 7,539,500 | 10,288,613 | 6,651,224 |
| Virginia | 3,040 | 106,400 | 1,484 | 959 |
| Washington | 68,103 | 2,383,600 | 311,345 | 201,273 |
| Wyoming | 860 | 30,100 | 462 | 299 |
| | 5,089,811 | 178,143,400 | 62,665,335 | 40,510,924 |

[1] Gold valued at $35 per fine ounce.
[2] Silver valued as follows: 1934, $0.646+ per fine ounce; 1935, $0.71875; 1936, $0.7745; 1937, $0.7735; 1938, $0.646+.

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The quantity of gold reclaimed in 1937 from old jewelry, dental waste, scrap, and other material received at private refineries and the United States mints and assay offices was 1,040,227 ounces and that sold for industrial use 1,132,067 ounces, the difference (91,840 ounces) representing the quantity of new gold absorbed by the arts and industries during the year. From 1932 to 1936, inclusive, the quantity of gold returned from industrial to monetary use exceeded that issued for industrial use by 3,367,400 ounces. Secondary silver recovered in 1937 from silverware, photographic film, and other sources totaled 23,564,986 ounces and that issued for use in the industrial arts 51,292,270 ounces, indicating that 27,727,284 ounces of new silver were required for industrial use.

*Gold and silver produced in the United States, 1792–1937*

[From Report of the Director of the Mint. The estimate for 1792–1873 is by R. W. Raymond, commissioner of mining statistics, and since then by the Director of the Mint]

| Period | Gold | | Silver | |
|---|---|---|---|---|
| | Fine ounces | Value [1] | Fine ounces | Value [2] |
| 1792–1847 | 1,187,170 | $24,537,000 | 309,500 | $404,500 |
| 1848–72 | 58,279,778 | 1,204,750,000 | 118,568,200 | 157,749,900 |
| 1873–1937 | 185,277,723 | 4,057,307,600 | 3,340,725,083 | 2,529,688,502 |
| | 244,744,671 | 5,286,594,600 | 3,459,602,783 | 2,687,842,902 |

[1] Gold valued in 1934 and thereafter at $35 per fine ounce; prior thereto at $20.67+ per fine ounce. Dollar figures are rounded.

[2] Silver valued in 1934 and thereafter at Government's average buying price for domestic product: In 1934 at $0.64+ per fine ounce, in 1935 at $0.71875, in 1936 at $0.7745, and in 1937 at $0.7735.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.777.

## PRICES OF GOLD AND SILVER

*Gold.*—Under the Gold Reserve Act of 1934 the value of gold was fixed by Presidential proclamation on January 31, 1934, at $35 per fine troy ounce and has remained at that figure through 1938. From January 18, 1837,[1] through 1932, the price was $20.67+ per ounce, and in 1933 the legal coinage value was continued at $20.67+. The average weighted price per fine ounce in 1933, as computed by the Bureau of Mines, was $25.56 and in 1934, $34.95. A complete account of regulations pertaining to gold and silver in 1933–34 is given in the chapter on Gold and Silver in Minerals Yearbook, 1934 (pp. 25–46), issued by the Bureau of Mines.

*Silver.*—The Government price of $0.7757+ for newly mined silver was maintained throughout 1936 and 1937, but was reduced by Presidential proclamation on December 31, 1937 to $0.64646464+ and continued at that price through 1938. The annual average prices[2] used for domestic silver from 1932 to 1938 are as follows: 1932,

[1] For Congressional acts with reference to coinage from Apr. 2, 1792, to Jan. 31, 1934, see Minerals Yearbook, 1937, p. 113; for gold prices in London, 1931–36, p. 114.

[2] For highest, lowest, and average price of silver in New York, 1874–1935, see Minerals Yearbook, 1937, p. 115; for ratio of silver to gold, 1687–1935, p. 121.

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$0.282; 1933, $0.350; 1934, $0.64646464; 1935, $0.71875; 1936, $0.7745; 1937, $0.7735; 1938, $0.64646464.

The following table, copied from the Annual Report of the Director of the Mint for the Fiscal Year Ended June 30, 1938, shows the price of silver in London and in New York in 1937 and the first half of 1938.

*Price of silver in London and in New York, 1937–38*

[From the Report of the Director of the Mint]

| Month | London price per ounce, 0.925 fine [1] | | | Average monthly exchange, New York on London | United States equivalent, per fine ounce, of London price at current rate of exchange | Average monthly New York price of fine bar silver, per ounce (mean of bid and asked quotations) |
|---|---|---|---|---|---|---|
| | Highest | Lowest | Average | | | |
| 1937 | *Pence* | *Pence* | *Pence* | *Dollars* | *Dollar* | *Dollar* |
| January | 21 5/16 | 20 1/4 | 20.7344 | 4.9075 | 0.45835 | 0.45224 |
| February | 20 3/16 | 19 15/16 | 20.0833 | 4.8939 | .44277 | .45062 |
| March | 21 1/8 | 20 3/16 | 20.6771 | 4.8851 | .45499 | .45442 |
| April | 21 1/2 | 20 3/16 | 20.7404 | 4.9163 | .45930 | .45772 |
| May | 20 7/16 | 20 1/4 | 20.3463 | 4.9399 | .45280 | .45337 |
| June | 20 3/8 | 19 3/4 | 20.0216 | 4.9355 | .44512 | .45130 |
| July | 20 3/16 | 19 13/16 | 19.9861 | 4.9672 | .44728 | .45062 |
| August | 20 | 19 3/16 | 19.8475 | 4.9822 | .44543 | .45062 |
| September | 20 | 19 3/4 | 19.8894 | 4.9530 | .44382 | .45062 |
| October | 20 1/16 | 19 13/16 | 19.9423 | 4.9551 | .44512 | .45062 |
| November | 19 15/16 | 19 9/16 | 19.7067 | 4.9961 | .44319 | .45062 |
| December | 19 11/16 | 18 9/16 | 18.8350 | 4.9964 | .42428 | .45062 |
| 1938 | | | | | | |
| January | 20 3/8 | 19 1/4 | 19.8950 | 4.9998 | .44807 | .45062 |
| February | 20 3/8 | 19 15/16 | 20.1588 | 5.0180 | .45567 | .45062 |
| March | 20 9/16 | 18 3/8 | 20.0880 | 4.9845 | .45103 | .44758 |
| April | 19 1/8 | 19 9/16 | 18.8804 | 4.9812 | .42338 | .43062 |
| May | 18 15/16 | 18 5/8 | 18.7307 | 4.9673 | .41898 | .43062 |
| June | 19 1/16 | 18 11/16 | 18.9450 | 4.9580 | .42315 | .43062 |
| Average, calendar year 1937 | | | 20.0675 | 4.9440 | .44687 | .45195 |
| Average, fiscal year 1937–38 | | | 19.5751 | 4.9799 | .43912 | .44537 |

[1] London price in depreciated currency after Sept. 21, 1931.

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## UNITED STATES AND WORLD MONETARY STOCKS

The following tables show, respectively, the value of the gold and silver held by the United States Treasury as of June 1, 1939, and of the gold reserves of central banks and governments as of March 31, 1939.

*Daily statement of current assets and liabilities of the United States Treasury, June 1, 1939*

GOLD

| Assets | | Liabilities | | |
|---|---|---|---|---|
| Gold (oz. 455,943,570.6) | $15,958,024,969.47 | Gold certificates: | | |
| | | Outstanding (outside of Treasury) | | $2,887,935,069.00 |
| | | Gold certificate fund—Board of Governors, Federal Reserve System | | 10,506,275,119.95 |
| | | Redemption fund—Federal Reserve notes | | 9,545,844.33 |
| | | Gold reserve | | 156,039,430.93 |
| | | NOTE.—Reserve against $346,681,016 of United States notes and $1,166,822 of Treasury notes of 1890 outstanding. Treasury notes of 1890 are also secured by silver dollars in the Treasury. | | |
| | | Exchange stabilization fund | | 1,800,000,000.00 |
| | | | | 15,359,795,464.21 |
| | | Gold in general fund: | | |
| | | Balance of increment resulting from reduction in the weight of the gold dollar | $142,351,032.26 | |
| | | In working balance | 455,878,473.00 | |
| | | | | 598,229,505.26 |
| Total | 15,958,024,969.47 | Total | | 15,958,024,969.47 |

SILVER

| | | | |
|---|---|---|---|
| Silver (oz. 938,480,993.5) | $1,213,389,567.46 | Silver certificates outstanding | $1,654,322,701.00 |
| Silver dollars (oz. 388,642,059.3) | 502,486,703.00 | Treasury notes of 1890 outstanding | 1,166,822.00 |
| | | Silver in general fund | 60,386,747.46 |
| Total | 1,715,876,270.46 | Total | 1,715,876,270.46 |

*Gold reserves of central banks and governments as of Mar. 31, 1939* [1]

| Country | Millions of dollars | Country | Millions of dollars |
|---|---|---|---|
| United States | 15,258 | Europe—Continued. | |
| Canada | 210 | Spain | 525 |
| | | Sweden | 332 |
| Europe: | | Other countries | 719 |
| United Kingdom [2] | 1,066 | | |
| France | 2,435 | Total (26 countries) [4] | 7,379 |
| Germany | 29 | Latin America (11 countries) | 656 |
| Italy | 193 | Asia and Oceania (8 countries) | 595 |
| Belgium | 518 | Africa (5 countries) | 299 |
| Netherlands | 909 | | |
| Switzerland [3] | 653 | Total (52 countries) [4] | 24,397 |

[1] Data from Federal Reserve Board.
[2] In addition, the British Exchange Equalization Account held $759,000,000 in gold, and an additional $1,648,000,000 transferred on Jan. 6, 1939, from Bank of England to Exchange Equalization Account for which next official report, that for March 31, will not be available until June 30.
[3] National Bank $640,000,000; B. I. S. $13,000,000.
[4] Stabilization funds in some countries not reported. Preliminary figure of Federal Reserve Board for total reserves of the 52 countries is $25,130,000,000.

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## IMPORTS AND EXPORTS [3]

*Value of gold and silver imported into and exported from the United States, 1937–38, by classes*

| | Imports | Exports | Excess of imports over exports |
|---|---|---|---|
| 1937 | | | |
| Gold: | | | |
| Contained in ore and base bullion | $74,214,974 | $933,764 | $73,281,210 |
| Bullion refined | 1,554,666,687 | 45,086,254 | 1,509,580,433 |
| United States coin | 1,965 | | 1,965 |
| Foreign coin | 2,639,644 | | 2,639,644 |
| | 1,631,523,270 | 46,020,018 | 1,585,503,252 |
| Silver: | | | |
| Contained in ore and base bullion | 21,540,648 | 616,435 | 20,924,213 |
| Bullion refined | 48,320,445 | 952,435 | 47,368,010 |
| United States coin | 278,422 | 9,582 | 268,840 |
| Foreign coin | 21,737,469 | 10,463,887 | 11,273,582 |
| | 91,876,984 | 12,042,339 | 79,834,645 |
| 1938 | | | |
| Gold: | | | |
| Contained in ore and base bullion | 77,627,999 | 882,874 | 76,745,125 |
| Bullion refined | 1,885,628,425 | 5,006,017 | 1,880,622,408 |
| United States coin | 291 | | 291 |
| Foreign coin | 16,200,804 | 13 | 16,200,791 |
| | 1,979,457,519 | 5,888,904 | 1,973,568,615 |
| Silver: | | | |
| Contained in ore and base bullion | 23,560,515 | 680,726 | 22,879,789 |
| Bullion refined | 82,711,006 | 790,293 | 81,920,713 |
| United States coin | 337,549 | 55 | 337,494 |
| Foreign coin | 123,922,067 | 5,611,079 | 118,310,988 |
| | 230,531,137 | 7,082,153 | 223,448,984 |

## DOMESTIC SUPPLY

The domestic supply of new gold comes chiefly from dry and siliceous ore and from placer gravel. These two sources yielded 90 percent of the domestic gold (excluding Philippine Islands and Puerto Rico) in 1915, 80 percent in 1930, 87 percent in 1931, 93 percent in 1932, 1933, and 1934, 91 percent in 1935, 88 percent in 1936, 85 percent in 1937, and 90 percent in 1938. The proportionate output of gold from copper ore was 7 percent in 1915, 16 percent in 1930, 10 percent in 1931, 4 percent in 1932, 5 percent in 1933 and 1934, 7 percent in 1935, 10 percent in 1936, 12 percent in 1937, and 8 percent in 1938. These sources accounted for 96 to 98 percent of the gold supply in 1915 and 1930–38.

In 1915 dry and siliceous ore yielded 36 percent of the total silver; copper ore, 26 percent; lead ore, 27 percent; and zinc-lead ore, 9 percent. In 1937 dry and siliceous ores yielded 45 percent and in 1938, 52 percent; copper ore, 29 percent and 26 percent; lead ore, 7 percent and 5 percent; and zinc-lead ore, 19 percent and 17 percent. The rounded percentage figures for both 1937 and 1938 include some silver (less than 0.8 percent in each instance) from zinc ore, mixed base-metal ores, and placer gravel.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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## WORLD PRODUCTION OF GOLD AND SILVER

According to the Bureau of the Mint the world output of gold and silver from 1493 to 1937 is 1,256,992,826 fine ounces of gold valued at $27,774,074,919 and 16,446,205,815 fine ounces of silver valued at $15,137,077,346.

The following tables show the world output of gold and silver from 1934 to 1938.

*World production of gold, 1934–38, by countries, in fine ounces* [1]

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | | | |
| United States: | | | | | |
| Continental | 2,741,660 | 3,163,103 | 3,759,162 | 4,804,523 | [2] 4,245,367 |
| Puerto Rico | 46 | 63 | 483 | 17 | 9 |
| Canada | 2,972,074 | 3,284,890 | 3,748,028 | 4,096,213 | 4,715,480 |
| Central America and West Indies: | | | | | |
| Costa Rica | 10,315 | 10,311 | 32,500 | 13,164 | [3] 17,500 |
| Cuba | (4) | (4) | [3] 2,140 | 12,200 | 4,700 |
| Dominican Republic (exports) | 5,312 | 7,553 | 8,901 | 7,102 | 5,275 |
| Guatemala | 7,500 | 4,221 | 1,824 | 4,180 | 5,466 |
| Honduras | 14,342 | 13,286 | 15,176 | 39,584 | 32,600 |
| Nicaragua | 19,424 | 16,193 | 23,077 | 24,242 | 44,301 |
| Panama | 15,604 | 5,705 | 9,189 | 14,000 | [3] 4,900 |
| Salvador | 6,824 | 8,129 | 8,928 | 8,564 | 14,566 |
| Other countries [5] | 43,700 | 52,400 | 33,300 | 17,000 | 10,700 |
| Mexico | 607,649 | 682,335 | 753,967 | 846,381 | 923,819 |
| Newfoundland | 11,219 | 12,728 | 16,114 | 22,470 | 21,104 |
| | 6,463,000 | 7,278,000 | 8,413,000 | 9,910,000 | 10,049,000 |
| South America: | | | | | |
| Argentina | 1,200 | 9,902 | 12,217 | 10,449 | (4) |
| Bolivia | [3] 11,600 | [3] 19,850 | 32,151 | 37,092 | (4) |
| Brazil | 141,729 | 120,597 | 125,405 | 145,771 | 142,899 |
| Chile | 237,658 | 265,944 | 248,799 | 272,704 | 294,001 |
| Colombia | 344,140 | 328,999 | 389,495 | 442,222 | 520,715 |
| Ecuador | 66,427 | 71,512 | 78,685 | 59,500 | 74,042 |
| Guiana: | | | | | |
| British | 25,420 | 30,488 | 32,234 | 35,993 | 39,726 |
| Dutch (Surinam) | 11,896 | 11,349 | 14,258 | 12,756 | 14,154 |
| French | 45,525 | 47,390 | 45,546 | 47,101 | 40,637 |
| Peru | 98,853 | 110,962 | 152,409 | 168,669 | 254,473 |
| Uruguay | | | | | 657 |
| Venezuela | 109,055 | 112,390 | 109,996 | 116,519 | 112,085 |
| | 1,093,503 | 1,129,383 | 1,241,195 | 1,348,776 | 1,545,000 |
| Europe: | | | | | |
| Czechoslovakia | 7,588 | 16,575 | 16,218 | 9,930 | 10,000 |
| Finland | | 4,630 | 4,919 | 4,822 | 3,858 |
| France | 101,500 | 91,598 | 85,682 | 66,423 | 70,700 |
| Germany | 5,755 | 5,958 | 7,584 | 8,028 | (4) |
| Austria | | | | 140 | (4) |
| Hungary | 1,833 | 1,479 | 836 | 5,159 | 5,655 |
| Italy | 2,476 | 2,894 | 3,697 | 3,103 | (4) |
| Norway | 129 | 231 | 42 | 96 | (4) |
| Portugal | 27 | | 3,282 | 3,982 | 6,186 |
| Rumania | 120,040 | 143,424 | 150,755 | 166,540 | 172,453 |
| Spain | 7,588 | 4,823 | 4,019 | (4) | (4) |
| Sweden | 246,693 | 180,559 | 158,342 | 193,226 | 197,984 |
| Switzerland | | 804 | 965 | 964 | 1,125 |
| U. S. S. R. [3] | 3,633,000 | 4,547,000 | 5,327,000 | 5,359,000 | 5,236,000 |
| United Kingdom | 51 | 148 | 1 | 60 | 2,400 |
| Yugoslavia | 71,342 | 74,172 | 84,106 | 87,578 | 78,301 |
| | 4,198,000 | 5,074,000 | 5,847,000 | 5,912,000 | 5,799,000 |

See footnotes at end of table.

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*World production of gold, 1934–38, by countries, in fine ounces*—Continued

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Asia: | | | | | |
| Burma | 900 | 1,483 | 1,439 | 1,004 | 1,063 |
| China | 154,966 | (4) | (4) | (4) | (4) |
| Chosen | 417,960 | 472,948 | 562,316 | 734,585 | [3] 730,000 |
| Cyprus (exports) | 13,092 | 6,872 | 20,991 | 23,650 | 30,366 |
| India, British | 321,253 | 326,170 | 331,946 | 330,744 | 321,334 |
| Indochina | 6,880 | 9,774 | 9,025 | 9,870 | (4) |
| Japan | 486,987 | 588,161 | 713,685 | 723,375 | [3] 760,000 |
| Malay States: | | | | | |
| Federated | 30,221 | 29,771 | 37,779 | 33,828 | 40,209 |
| Unfederated | 1,197 | 276 | 761 | 519 | 546 |
| Netherland India | 71,866 | 68,256 | 71,664 | 55,621 | 76,422 |
| Philippine Islands | 340,316 | 451,814 | 597,266 | 716,967 | 903,265 |
| Sarawak | 28,842 | 28,549 | 23,372 | 19,214 | 18,520 |
| Siam | (4) | 10,337 | 10,353 | 11,045 | 9,016 |
| Taiwan | 33,636 | 37,217 | 41,608 | [3] 50,000 | (4) |
| Turkey | | | | | 514 |
| | 1,918,000 | 2,197,000 | 2,607,000 | 2,825,000 | 3,035,000 |
| Africa: | | | | | |
| Bechuanaland | 9,486 | 11,419 | 16,746 | 17,577 | 19,111 |
| Belgian Congo | 329,449 | 370,409 | 389,281 | 431,688 | [3] 460,000 |
| Cameroons, French | 418 | 2,829 | 11,027 | 14,225 | 15,540 |
| Egypt | 201 | 58 | 278 | 1,226 | 2,129 |
| Eritrea | 8,040 | 4,286 | 1,608 | (4) | (4) |
| Ethiopia | [3] 10,000 | 13,736 | 25,700 | (4) | (4) |
| French Equatorial Africa | 28,839 | 27,971 | 22,088 | 21,490 | 40,028 |
| French West Africa (exports) | 97,706 | 125,677 | 114,424 | 128,217 | 127,220 |
| Gold Coast | 326,040 | 358,835 | 428,144 | 559,212 | 674,927 |
| Kenya Colony | 12,110 | 23,009 | 38,463 | 54,774 | 69,436 |
| Liberia | | 965 | [6] 1,567 | 2,457 | [6] 1,902 |
| Madagascar | 15,979 | 15,465 | 15,111 | 13,471 | [6] 12,699 |
| Morocco, French | | 780 | 1,500 | 4,630 | (4) |
| Nigeria | 37,023 | 38,962 | 33,364 | 26,466 | 24,815 |
| Nyasaland | 84 | 127 | 30 | 2 | (4) |
| Portuguese East Africa | 19,641 | 6,379 | 8,223 | 11,129 | 17,328 |
| Rhodesia: | | | | | |
| Northern | 2,113 | 1,647 | 4,452 | 4,228 | 1,113 |
| Southern | 691,152 | 726,281 | 797,061 | 804,219 | 814,078 |
| Sierra Leone | 21,205 | 30,753 | 37,966 | 35,717 | 30,457 |
| South-West Africa | 908 | 3,206 | 4,065 | 2,804 | (4) |
| Sudan | 5,398 | 8,550 | 7,659 | 7,388 | 8,866 |
| Swaziland | 379 | 314 | 276 | 2,410 | 9,035 |
| Tanganyika | 42,606 | 52,182 | 69,675 | 75,281 | 86,162 |
| Uganda | 5,842 | 5,651 | 13,231 | 16,947 | 20,502 |
| Union of South Africa | 10,479,857 | 10,773,991 | 11,336,214 | 11,734,575 | 12,161,392 |
| | 12,144,000 | 12,603,000 | 13,378,000 | 14,002,000 | 14,636,000 |
| Oceania: | | | | | |
| Australia: | | | | | |
| New South Wales | 36,123 | 50,102 | 60,739 | 68,607 | 88,698 |
| Northern Territory | 2,147 | 9,272 | 7,705 | 11,563 | 12,378 |
| Queensland | 115,471 | 102,990 | 121,174 | 127,281 | 151,432 |
| South Australia | 6,870 | 7,333 | 7,681 | 6,962 | 5,292 |
| Victoria | 73,196 | 87,609 | 113,940 | 145,799 | 144,243 |
| Western Australia | 639,871 | 646,150 | 852,422 | 1,000,647 | 1,167,791 |
| Fiji | 931 | 6,728 | 16,955 | 24,917 | 92,362 |
| New Guinea | 184,505 | 184,009 | 220,974 | 217,152 | 236,133 |
| New Zealand | 160,248 | 165,277 | 164,575 | 168,487 | [6] 151,162 |
| Papua | 12,591 | 17,012 | 20,719 | 22,153 | 27,000 |
| Tasmania | 5,622 | 8,343 | 17,600 | 20,276 | 22,200 |
| | 1,234,575 | 1,284,825 | 1,604,484 | 1,813,844 | 2,098,691 |
| | 27,050,000 | 29,565,000 | 33,090,000 | 35,810,000 | 37,165,000 |

[1] Prepared with the cooperation of the Office of the Director of the Mint. All figures for 1938 preliminary and subject to revision. No official statistics are issued by the Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable. This table records only official production and export figures. In some countries accurate figures are not possible to obtain, due to clandestine trade in gold.

[2] Refinery production.

[3] Approximate production.

[4] Data not available. Estimate included in total.

[5] Purchases by the Central Bank of Bolivia.

[6] Exports.

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*World production of silver, 1934–38, by countries, in fine ounces* [1]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 (preliminary) |
|---|---|---|---|---|---|
| North America: | | | | | |
| United States [2] | 32,486,879 | 45,612,918 | 63,350,587 | 71,298,929 | 61,688,834 |
| Canada | 16,415,282 | 16,618,558 | 18,334,487 | 22,977,751 | 22,157,154 |
| Central America and West Indies: | | | | | |
| Honduras | 3,091,522 | 2,641,346 | 3,104,507 | 3,211,296 | 3,335,070 |
| Other countries [3] | 408,000 | 859,000 | 495,000 | 390,000 | 365,000 |
| Mexico | 74,145,012 | 75,589,199 | 77,463,901 | 84,680,875 | 81,018,809 |
| Newfoundland | 1,103,091 | 1,123,997 | 1,249,472 | 1,447,637 | 1,668,622 |
| | 127,650,000 | 142,445,000 | 163,998,000 | 184,006,000 | 170,233,000 |
| South America: | | | | | |
| Argentina | 60,000 | 49,994 | 512,322 | 2,121,000 | 3,755,000 |
| Bolivia | 5,216,297 | 7,951,000 | 10,723,333 | 9,454,000 | 6,386,000 |
| Brazil [4] | 22,275 | 20,833 | 23,887 | 25,238 | 25,585 |
| Chile | 1,051,140 | 1,298,755 | 1,498,163 | 1,789,768 | 1,414,118 |
| Colombia | 127,461 | 132,965 | 151,501 | 167,971 | 192,880 |
| Ecuador | 110,815 | 80,658 | 96,310 | 98,500 | 89,100 |
| Guiana, British | 3,340 | 4,010 | 4,240 | 4,740 | (5) |
| Peru | 10,366,929 | 17,104,300 | 19,915,101 | 16,993,732 | 20,424,466 |
| | 16,958,000 | 26,643,000 | 32,925,000 | 30,655,000 | 32,292,000 |
| Europe: | | | | | |
| Czechoslovakia | 971,370 | 1,329,734 | 1,088,718 | 1,103,444 | [3] 1,190,000 |
| Finland | (5) | (5) | (5) | 57,900 | 57,900 |
| France | 303,985 | 569,615 | 473,323 | 563,860 | [3] 565,000 |
| Germany | 5,944,029 | 6,257,788 | 6,541,551 | 6,774,000 | (5) |
| Austria | 14,017 | 11,863 | 29,061 | 9,774 | (5) |
| Greece [4 6] | 525,791 | 217,906 | 526,623 | 370,000 | (5) |
| Hungary | 9,163 | 4,983 | 3,794 | 50,965 | 46,631 |
| Italy | 373,217 | 453,283 | 616,000 | 715,000 | 780,000 |
| Norway | 200,103 | 266,851 | 228,270 | 282,904 | 241,000 |
| Poland | 21,155 | 32,311 | 60,507 | 64,237 | 62,244 |
| Portugal | | | 12,905 | 178 | 16,742 |
| Rumania | 417,670 | 471,876 | 594,757 | 670,214 | 819,816 |
| Spain | 1,788,289 | 861,640 | [6] 900,000 | [6] 600,000 | [6] 500,000 |
| Sweden | 754,514 | 835,791 | 939,541 | 946,261 | 1,040,000 |
| U. S. S. R. [3] | 3,665,000 | 4,850,000 | 6,590,000 | 7,230,000 | 8,040,000 |
| United Kingdom | 138,955 | 92,851 | 76,872 | 71,439 | 108,000 |
| Yugoslavia | 1,748,000 | 1,753,534 | 1,785,620 | 2,242,546 | 2,524,074 |
| | 16,920,000 | 18,061,000 | 20,518,000 | 21,753,000 | 23,121,000 |
| Asia: | | | | | |
| Burma | 5,792,019 | 5,825,913 | 5,952,000 | 6,180,000 | 5,920,000 |
| China [4] | 147,594 | 150,000 | 150,000 | 201,000 | (5) |
| Chosen | 1,005,906 | 1,264,986 | 1,891,137 | 2,672,978 | (5) |
| Cyprus (exports) | 128,264 | 44,536 | 125,704 | 132,968 | 200,018 |
| Hong Kong | | | | | 111,070 |
| India, British | 25,505 | 24,493 | 25,345 | 24,642 | 26,794 |
| Indochina | 3,601 | 3,633 | 5,594 | 3,537 | 2,411 |
| Japan | 6,882,156 | 8,230,751 | 9,765,572 | 9,902,000 | [3] 10,100,000 |
| Netherland India | 771,361 | 701,722 | 662,654 | 500,105 | 579,292 |
| Philippine Islands | 212,613 | 322,022 | 491,701 | 719,771 | 1,166,612 |
| Sarawak | | | | | 1,660 |
| Taiwan | 9,547 | 10,584 | 12,936 | (5) | (5) |
| Turkey [6] | 250,000 | 200,000 | 300,000 | 380,000 | 305,000 |
| | 15,229,000 | 16,779,000 | 19,383,000 | 20,732,000 | 21,528,000 |
| Africa: | | | | | |
| Algeria | 1,929 | 46,522 | 45,236 | 72,177 | 90,000 |
| Bechuanaland | 957 | 1,758 | 1,378 | 1,499 | 1,127 |
| Belgian Congo | 3,399,362 | 3,793,980 | 2,781,521 | 2,962,337 | 3,119,000 |
| Gold Coast [4] | 11,000 | 12,000 | 14,000 | 19,000 | (5) |
| Kenya Colony | 1,969 | 3,744 | 5,721 | 7,549 | 10,340 |
| Morocco, French | | 2,733 | 88,254 | 72,178 | (5) |
| Nigeria | 81,000 | 139,200 | 153,000 | 102,120 | (5) |
| Portuguese East Africa | 763 | 725 | 1,337 | 1,474 | 1,808 |
| Rhodesia: | | | | | |
| Northern | 187 | 151 | 229,151 | 83,861 | 88,237 |
| Southern | 128,381 | 132,087 | 145,072 | 152,038 | 166,419 |
| Sierra Leone | 1,400 | 1,673 | 1,537 | 1,568 | (5) |
| Tanganyika | 4,876 | 6,134 | 9,254 | 11,696 | 16,620 |
| Tunisia | 22,023 | 17,008 | 44,979 | 174,638 | 86,000 |
| Uganda | 383 | 346 | 924 | 1,379 | 1,981 |
| Union of South Africa | 1,002,203 | 1,042,203 | 1,075,626 | 1,100,641 | 1,131,708 |
| | 4,656,000 | 5,200,000 | 4,597,000 | 4,764,000 | 4,907,000 |

See footnotes at end of table.



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*World production of silver, 1934–38, by countries, in fine ounces*—Continued

| Country | 1934 | 1935 | 1936 | 1937 | 1938 (preliminary) |
|---|---|---|---|---|---|
| Oceania: | | | | | |
| Australia: | | | | | |
| New South Wales | 8,207,520 | 9,091,946 | 8,557,803 | 9,780,499 | [3] 9,500,000 |
| Queensland | 2,259,574 | 2,409,165 | 3,084,008 | 3,264,994 | 3,533,490 |
| South Australia | | | 1,560 | 955 | 503 |
| Victoria | 3,106 | 3,948 | 7,964 | 5,443 | 5,898 |
| Western Australia | 45,765 | 50,516 | 76,798 | 180,562 | 271,346 |
| Fiji | | 634 | 1,185 | 3,463 | 12,380 |
| New Guinea [4] | 81,000 | 83,000 | 97,000 | 96,000 | 141,760 |
| New Zealand | 382,615 | 437,967 | 432,973 | 443,981 | 369,896 |
| Tasmania | 284,687 | 323,901 | 906,458 | 1,060,785 | 1,219,550 |
| | 11,264,267 | 12,401,077 | 13,165,749 | 14,836,682 | 15,055,000 |
| | 192,675,000 | 221,530,000 | 254,585,000 | 276,745,000 | 267,135,000 |

[1] Preliminary world silver production table prepared with revisions and adjustments by R. B. Miller, Foreign Minerals Division, Bureau of Mines, in cooperation with the Office of the Director of the Mint. No official statistics are issued by the Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable.
[2] Philippine Islands excluded.
[3] Approximate production.
[4] Imperial Institute (London), Statistical Summary.
[5] Estimate included in total.
[6] American Bureau of Metal Statistics (New York), Annual Issue.

## MINE REPORT

### METHOD OF COLLECTING STATISTICS

The first table in this report presents the official refinery figures of the production of gold and silver in the United States from 1933 to 1937, as agreed upon by the Bureau of the Mint and the Bureau of Mines. With the comparatively unimportant exceptions of domestic gold and silver contained in ore and matte exported for reduction during the year, these figures record the production of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace the gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines systematically investigates the "mine production" of ores containing gold and silver and the output of the placer mines, the total being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two plans for ascertaining the production of gold and silver, one is a measure of the metallurgic industry and the other of the mining industry; one reports the metal actually recovered in marketable form and the other the mine output and its recoverable content. The two methods will not produce identical results, but the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error.

*Gold and silver produced in the United States, 1905–37, in fine ounces, according to mint and mine returns*

| Year | Mint | | Mine | |
|---|---|---|---|---|
| | Gold | Silver | Gold | Silver |
| 1905–33 | 98,362,334 | 1,683,625,006 | 97,977,476 | 1,672,297,719 |
| 1934 | 3,091,183 | 32,725,353 | 3,119,159 | 32,995,017 |
| 1935 | 3,609,283 | 45,924,454 | 3,688,832 | 48,840,669 |
| 1936 | 4,357,394 | 63,812,176 | 4,405,118 | 61,647,455 |
| 1937 | 4,804,540 | 71,941,794 | 4,834,062 | 72,128,397 |
| | 114,224,734 | 1,898,028,783 | 114,024,647 | 1,887,909,257 |

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Compared with the mine reports the mint reports show a total excess of gold for the 33 years of 200,087 ounces (a difference of 0.18 percent) and a total excess of silver of 10,119,526 ounces (a difference of 0.54 percent).

## UNITS OF MEASUREMENT

All tonnage figures are short tons of 2,000 pounds "dry weight"; that is, they do not include moisture. The weight unit for gold and silver is the troy ounce (480 grains). The totals are calculated on the basis of recovered and recoverable fine gold and silver shown by assays to be contained in ore, bullion, and other material produced. Prices of gold and silver are discussed in a preceding section of this report.

## MINES PRODUCING

### LEADING GOLD PRODUCERS

The output of the 25 largest gold producers in the United States (Philippine Islands and Puerto Rico excluded) in 1938, none of which produced less than 19,700 ounces, was 2,087,123 fine ounces (49 percent of the total) compared with 2,165,642 ounces (52.5 percent of the total) in 1937. Decreases in 1938 in the quantity of gold recovered by several large copper-producing companies caused most of the reduction in the proportion of the total gold produced by the 25 largest producers. Four of the companies, working placer mines with floating connected-bucket dredges, recovered 397,471 ounces of gold; the remainder of the output of the largest producers came from lode mines.

*Largest producers of gold in the United States in 1938, in order of output* [1]

| Rank | Operator | State | Mining district | Source of gold |
|---|---|---|---|---|
| 1 | Homestake Mining Co | South Dakota | Whitewood | Dry and siliceous ore. |
| 2 | United States Smelting, Refining & Mining Co. | Alaska | Fairbanks and Nome | Dredging gravel. |
| 3 | Golden Cycle Corporation [2] | Colorado | Cripple Creek, etc | Dry and siliceous ore. |
| 4 | Alaska Juneau Mining Co | Alaska | Juneau | Do. |
| 5 | Empire Star Mines Co., Ltd | California | Grass Valley-Nevada City. | Do. |
| 6 | Idaho Maryland Mines Corporation. | do | do | Do. |
| 7 | Phelps Dodge Corporation | Arizona | Ajo, Verde, Warren | Copper ore. |
| 8 | Utah Copper Co | Utah | West Mountain | Do. |
| 9 | Yuba Consolidated Gold Fields. | California | Callahan, Oroville, Snelling, Yuba River. | Dredging gravel. |
| 10 | Natomas Co | do | Folsom | Do. |
| 11 | Capital Dredging Co | do | do | Do. |
| 12 | Black Mammoth Consolidated Mining Co. | Nevada | Silver Peak | Gold ore. |
| 13 | Howe Sound Co | Washington | Chelan | Copper ore. |
| 14 | Lava Cap Gold Mining Corporation. | California | Grass Valley-Nevada City. | Dry and siliceous ore. |
| 15 | Central Eureka Mining Co | do | Mother Lode | Do. |
| 16 | United States Smelting, Refining & Mining Co. | Utah | West Mountain and Tintic. | Zinc-lead ore, lead ore, dry and siliceous ore. |
| 17 | The Mountain Copper Co., Ltd. | California | Iron Mountain-West Belt. | Dry and siliceous ore. |
| 18 | Consolidated Coppermines Corporation. | Nevada | Robinson | Copper ore. |
| 19 | United States Smelting, Refining & Mining Co. (Gold Road). | Arizona | San Francisco | Dry and siliceous ore. |
| 20 | Carson Hill Gold Mining Corporation. | California | Mother Lode | Do. |
| 21 | Bald Mountain Mining Co | South Dakota | Trojan | Do. |
| 22 | Getchell Mines, Inc | Nevada | Potosi | Do. |
| 23 | London Mines & Milling Co | Colorado | Mosquito | Do. |
| 24 | Golden Queen Mining Co | California | Mojave | Do. |
| 25 | Summitville Consolidated Mines, Inc. | Colorado | Summitville | Do. |

[1] Philippine Islands excluded.
[2] Custom mill. Includes mainly ore from Cresson, Portland, Ajax, and other mines in Cripple Creek district, Colo., but also from other districts in Colorado.

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The Benguet Consolidated Mining Co. (including the Balatoc mine, controlled by Benguet stockholders) in the Philippine Islands ranked between the Homestake Mining Co. and the United States Smelting, Refining & Mining Co. Alaska operations.

### LEADING SILVER PRODUCERS

The output of silver from the 25 leading silver-producing companies in 1938, none of which produced less than 329,000 ounces, was 44,522,432 ounces—72 percent of the total mine output of the United States (Philippine Islands and Puerto Rico excluded); in 1937 the 25 leading companies produced 51,073,186 ounces, also 72 percent of the total mine output.

*Largest producers of silver in the United States in 1938, in order of output*

| Rank | Operator | State | Mining district | Source of silver |
|---|---|---|---|---|
| 1 | Sunshine Mining Co | Idaho | Evolution | Dry and siliceous ore. |
| 2 | New Jersey Zinc Co., Empire Zinc Division. | Colorado | Battle Mountain | Copper ore. |
| 3 | Anaconda Copper Mining Co. | Montana | Summit Valley | Copper ore, zinc-lead ore. |
| 4 | Phelps Dodge Corporation | Arizona | Ajo, Verde, Warren | Copper ore. |
| 5 | United States Smelting, Refining & Mining Co. | Utah | West Mountain, Tintic. | Zinc-lead ore, lead ore, dry and siliceous ore. |
| 6 | Tintic Standard Mining Co | do | Tintic | Dry and siliceous ore, lead ore. |
| 7 | Bunker Hill & Sullivan Mining & Concentrating Co. | Idaho | Yreka | Zinc-lead ore, dry and siliceous ore. |
| 8 | Polaris Mining Co | do | Evolution | Dry and siliceous ore. |
| 9 | American Metal Co. (Presidio mine). | Texas | Shafter | Do. |
| 10 | Hecla Mining Co | Idaho | Lelande | Lead ore, zinc-lead ore. |
| 11 | Park City Consolidated Mines Co. | Utah | Blue Lodge | Zinc-lead ore. |
| 12 | Federal Mining & Smelting Co. | Idaho | Hunter, Lelande, Yreka. | Do. |
| 13 | Snyder Mines, Inc | do | Warm Springs | Do. |
| 14 | Utah Copper Co | Utah | West Mountain | Copper ore. |
| 15 | Desert Silver, Inc | Nevada | Silver Peak | Silver ore. |
| 16 | Cactus Mines Co | California | Mojave | Dry and siliceous ore. |
| 17 | Eagle-Picher Mining & Smelting Co. | Arizona | Oro Blanco | Zinc-lead ore. |
| 18 | Veta Mines, Inc | do | Ash Peak | Dry and siliceous ore. |
| 19 | Anaconda Copper Mining Co. (Flathead mine). | Montana | Hog Heaven | Do. |
| 20 | Magma Copper Co | Arizona | Pioneer | Copper ore, copper-zinc ore. |
| 21 | Tonopah Mining Co. of Nevada. | Nevada | Tonopah | Gold-silver ore. |
| 22 | Silver King Coalition Mines Co. | Utah | Uintah | Zinc-lead ore, lead ore. |
| 23 | Black Hawk Consolidated Mines Co. | New Mexico | Mogollon | Dry and siliceous ore. |
| 24 | Chief Consolidated Mining Co. | Utah | Tintic | Dry and siliceous ore, lead ore, zinc-lead ore. |
| 25 | Shenandoah-Dives Mining Co. | Colorado | Animas | Dry and siliceous ore. |

### NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1937 and 1938. The placers are those in which the gold and the silver in natural alloy with the gold and, in a few placers, with platinum are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those yielding gold and silver (from ore as distinguished from gravel)

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mainly from underground workings, including those that yield ore valuable chiefly for copper, lead, or zinc but that contribute precious metals as byproducts. In addition to producing mines enumerated here many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of lode mines, because some are operated only temporarily and are individually small and because much of the production is made by transitory miners not regularly working placer ground. So far as possible the unit, as for lode mines, is not the operator but the mining claim or group of claims.

*Number of mines in the United States producing gold and silver, 1937–38, by States* [1]

| State | Lode | | Placer | | Total | |
|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 |
| Alabama | 2 | 1 | 2 | 2 | 4 | 3 |
| Alaska [2] | 61 | 70 | 1,177 | 1,164 | 1,238 | 1,234 |
| Arizona | 888 | 885 | 376 | 329 | 1,264 | 1,214 |
| California | 913 | 927 | 838 | 676 | 1,751 | 1,603 |
| Colorado | 655 | 669 | 490 | 592 | 1,145 | 1,261 |
| Georgia | 8 | 7 | 29 | 15 | 37 | 22 |
| Idaho | 347 | 305 | 741 | 463 | 1,088 | 768 |
| Illinois [3] | 2 | 2 | | | 2 | 2 |
| Maryland | 1 | 2 | | | 1 | 2 |
| Michigan [3] | 2 | 2 | | | 2 | 2 |
| Missouri [3] | 1 | 1 | | | 1 | 1 |
| Montana | 615 | 482 | 406 | 265 | 1,021 | 747 |
| Nevada | 682 | 795 | 117 | 130 | 799 | 925 |
| New Mexico | 159 | 166 | 160 | 164 | 319 | 330 |
| New York [3] | 1 | 1 | | | 1 | 1 |
| North Carolina | 7 | 14 | 5 | 6 | 12 | 20 |
| Oregon | 104 | 84 | 150 | 157 | 254 | 241 |
| Pennsylvania | 1 | 1 | | | 1 | 1 |
| South Carolina | 3 | 10 | 1 | 2 | 4 | 12 |
| South Dakota | 14 | 11 | 73 | 71 | 87 | 82 |
| Tennessee [3] | 3 | 3 | | | 3 | 3 |
| Texas | 7 | 7 | | | 7 | 7 |
| Utah | 189 | 183 | 14 | 22 | 203 | 205 |
| Virginia [3] | 3 | 3 | 3 | 1 | 6 | 4 |
| Washington | 65 | 77 | 90 | 80 | 155 | 157 |
| Wyoming | 3 | 8 | 27 | 26 | 30 | 34 |
| | 4,736 | 4,716 | 4,699 | 4,165 | 9,435 | 8,881 |

[1] Philippine Islands and Puerto Rico excluded.
[2] Estimated.
[3] Number of mines contributing to production of gold or silver.

## MINE PRODUCTION

### SUMMARY

The following table gives the mine production of gold and silver in 1937 and 1938, by States, as reported to the Bureau of Mines by the producing mines. The annual percentage gains in gold production in the years following the 69-percent increase in the price of gold are as follows: 1934 over 1933, 19 percent; 1935 over 1934, 18 percent; 1936 over 1935, 19 percent; 1937 over 1936, 9 percent; and 1938 over 1937, 7 percent. The total gain in 1938 over 1933 was 97 percent. The output of silver decreased 13 percent in 1938 from 1937 but was still 170 percent above that in 1933.

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*Mine production of gold and silver in the United States, 1937–38, by regions and States, in terms of recovered metals*

| Region and State | Gold | | | | | Silver | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fine ounces | | Increase or decrease (percent) | Value (at $35 per ounce) | | Fine ounces | | Increase or decrease (percent) | Value | |
| | 1937 | 1938 | | 1937 | 1938 | 1937 | 1938 | | 1937 (at $0.7735 per ounce) | 1938 (at $0.646+ per ounce) |
| Western States and Alaska: | | | | | | | | | | |
| Alaska | 627,940.00 | 664,973.00 | +6 | $21,977,900 | $23,274,055 | 494,340 | 479,853 | −3 | $382,372 | $310,208 |
| Arizona | 332,694.00 | 305,043.00 | −8 | 11,644,290 | 10,676,505 | 9,422,552 | 7,479,153 | −21 | 7,288,344 | 4,835,008 |
| California | 1,174,578.00 | 1,311,129.00 | +12 | 41,110,230 | 45,889,515 | 2,888,265 | 2,590,804 | −10 | 2,234,073 | 1,674,863 |
| Colorado | 368,905.00 | 367,468.00 | (1) | 12,911,675 | 12,861,380 | 6,260,693 | 7,932,095 | +27 | 4,842,646 | 5,127,819 |
| Idaho | 81,861.00 | 103,513.00 | +26 | 2,865,135 | 3,622,955 | 19,587,766 | 18,993,676 | −3 | 15,151,137 | 12,278,740 |
| Montana | 202,252.00 | 203,313.00 | +1 | 7,078,820 | 7,115,955 | 11,812,093 | 6,403,962 | −46 | 9,136,654 | 4,139,935 |
| Nevada | 281,332.00 | 296,434.00 | +5 | 9,846,620 | 10,375,190 | 4,864,750 | 4,355,471 | −10 | 3,762,884 | 2,815,658 |
| New Mexico | 41,171.00 | 43,050.00 | +5 | 1,440,985 | 1,506,750 | 1,243,766 | 1,229,860 | −1 | 962,053 | 795,061 |
| Oregon | 52,662.00 | 81,729.00 | +55 | 1,843,170 | 2,860,515 | 60,564 | 100,507 | +66 | 46,846 | 64,974 |
| South Dakota | 581,544.00 | 594,847.00 | +2 | 20,354,040 | 20,819,645 | 139,638 | 162,295 | +16 | 108,010 | 104,918 |
| Texas | 562.00 | 439.00 | −22 | 19,670 | 15,365 | 1,325,660 | 1,433,008 | +8 | 1,025,398 | 926,389 |
| Utah | 322,759.00 | 200,630.00 | −38 | 11,296,565 | 7,022,050 | 12,869,117 | 9,682,732 | −25 | 9,954,262 | 6,259,544 |
| Washington | 36,310.00 | 74,175.00 | +104 | 1,270,850 | 2,596,125 | 126,304 | 380,938 | +202 | 97,696 | 246,263 |
| Wyoming | 1,776.00 | 798.00 | −55 | 62,160 | 27,930 | 203 | 328 | +62 | 157 | 212 |
| | 4,106,346.00 | 4,247,541.00 | +3 | 143,722,110 | 148,663,935 | 71,095,711 | 61,224,682 | −14 | 54,992,532 | 39,579,592 |
| Eastern States: | | | | | | | | | | |
| Alabama | 2,459.89 | 41.00 | −98 | 86,096 | 1,435 | 457 | 4 | −99 | 353 | 3 |
| Georgia | 742.72 | 872.00 | +17 | 25,995 | 30,520 | 49 | 71 | +45 | 38 | 46 |
| Maryland | 1,040.00 | 855.00 | −18 | 36,400 | 29,925 | 40 | 24 | −40 | 31 | 16 |
| New York | | | | | | 41,500 | 37,200 | −10 | 32,100 | 24,048 |
| North Carolina | 948.65 | 1,878.00 | +98 | 33,203 | 65,730 | 5,538 | 5,500 | −1 | 4,284 | 3,556 |
| Pennsylvania | 1,348.00 | 1,422.00 | +5 | 47,180 | 49,770 | 9,497 | 9,360 | −1 | 7,346 | 6,051 |
| South Carolina | 2,482.56 | 11,681.00 | +371 | 86,890 | 408,835 | 624 | 3,951 | +533 | 483 | 2,554 |
| Tennessee | 263.00 | 236.00 | −10 | 9,205 | 8,260 | 49,057 | 38,333 | −22 | 37,946 | 24,781 |
| Virginia | 1,396.08 | 2,943.00 | +111 | 48,863 | 103,005 | 111 | 502 | +352 | 86 | 325 |
| | 10,680.90 | 19,928.00 | +87 | 373,832 | 697,480 | 106,873 | 94,945 | −11 | 82,667 | 61,380 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Central States: | | | | | | | | | | |
| Illinois | | | | | | 887 | 576 | −35 | 686 | 372 |
| Michigan | 51.44 | | −100 | 1,800 | | 25,454 | 93,634 | +268 | 19,689 | 60,531 |
| Missouri | | | | | | 179,700 | 292,000 | +62 | 138,999 | 188,768 |
| | 51.44 | | −100 | 1,800 | | 206,041 | 386,210 | +87 | 159,374 | 249,671 |
| Philippine Islands | [2] 716,967.00 | [2] 903,265.00 | +26 | 25,093,845 | 31,614,275 | [2] 719,771 | 1,167,612 | +62 | 556,743 | 754,820 |
| Puerto Rico | 17.00 | 9.00 | −47 | 595 | 315 | 1 | 1 | | 1 | 1 |
| | 716,984.00 | 903,274.00 | +26 | 25,094,440 | 31,614,590 | 719,772 | 1,167,613 | +62 | 556,744 | 754,821 |
| | 4,834,062.34 | 5,170,743.00 | +7 | 169,192,182 | 180,976,005 | 72,128,397 | 62,873,450 | −13 | 55,791,317 | 40,645,464 |

[1] Less than 0.1 percent.

[2] Division of Statistics, Department of Agriculture and Commerce, Manila.



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*Gold and silver produced in the Western States of the United States, 1848–1938, and in Alaska, 1880–1938, in terms of recovered metals*

| State | Period | Gold | | Silver (fine ounces) |
|---|---|---|---|---|
| | | Fine ounces | Value [1] | |
| Arizona | 1860–1938 | 9,247,637 | $211,162,450 | 246,290,559 |
| California | 1848–1938 | 95,963,031 | 2,060,809,737 | 95,919,085 |
| Colorado | 1858–1938 | 37,182,538 | 795,265,794 | 692,441,670 |
| Idaho | 1863–1938 | 7,216,200 | 155,706,403 | 418,127,937 |
| Montana | 1862–1938 | 15,897,268 | 340,857,592 | 679,367,364 |
| Nevada | 1859–1938 | 23,663,592 | 506,787,396 | 565,384,135 |
| New Mexico | 1848–1938 | 2,048,013 | 45,014,648 | 61,139,542 |
| Oregon | 1852–1938 | 5,317,449 | 114,073,758 | 4,489,124 |
| South Dakota | 1876–1938 | 18,232,108 | 419,720,989 | 8,832,407 |
| Texas | 1885–1938 | 7,099 | 182,410 | 28,749,634 |
| Utah | 1864–1938 | 8,068,483 | 182,621,945 | 646,973,710 |
| Washington | 1860–1938 | 1,624,993 | 35,630,078 | 10,013,622 |
| Wyoming | 1867–1938 | 76,090 | 1,771,478 | 74,297 |
| Total, Western States | 1848–1938 | 224,544,501 | 4,869,604,678 | 3,457,803,086 |
| Alaska | 1880–1938 | 23,023,856 | 518,849,562 | 18,978,413 |
| Total, Western States and Alaska | 1848–1938 | 247,568,357 | 5,388,454,240 | 3,476,781,499 |

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67+; 1933, $25.56; 1934, $34.95; 1935–38, $35.

## ORE PRODUCTION, CLASSIFICATION, METAL YIELD, AND METHODS OF RECOVERY

The best index of lode mining is the quantity and metallic content of ore mined rather than the number of mines or operators. The following tables give details of classes of ore, metal yield in fine ounces of gold and silver to the ton, and gold and silver output by classes of ore and by methods of recovery, embracing all ores that produced gold and silver in the United States (excluding the Philippine Islands and Puerto Rico) in 1938. The individual State chapters from which these tables were compiled contain additional tables and text on the subject and may be found elsewhere in this volume.

The classification originally adopted in 1905 on the basis of smelter terminology, smelter settlement contracts, and smelter recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in recovery of metals and the lowering of grade of complex ores treated, accomplished by improved mill concentration processes. A "dry" ore is one that carries so little lead or copper that by itself in quantity it would not satisfy the requirements for the smelter charge in lead smelting or copper smelting, respectively. The copper ores include those smelting ores that contain 2.5 percent dry assay or more of copper (or less than this percentage if no other metal is present), or those ores concentrated chiefly for their copper content. The lead ores are those that contain 5 percent dry assay (minimum lead smelting charge requires 7.5 to 8.5 percent wet assay) or more of lead, irrespective of precious-metal content; an ore that carries any grade of lead exclusively is called a lead ore. Zinc smelting ores (chiefly oxides) range from 16 to 45 percent zinc; zinc concentrating ores include any grade of zinc ore that makes marketable zinc concentrate, irrespective of precious-metal content. The mixed ores are combinations of those enumerated. The smelter classification applies to concentrates.

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Siliceous (silica [4] in excess of iron) gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed ores are called "dry" ores regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content (chiefly the "porphyry coppers") and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry and siliceous ores" thus, by elimination, include both dry siliceous and irony, but chiefly siliceous, ores valuable for their gold and silver content, regardless of method of treatment, and dry fluxing ores carrying considerable quantities of iron and manganese oxides, or iron sulfide, and very small quantities of gold and silver. Dry and siliceous gold ores are those that by inspection are overwhelmingly of gold content; a similar qualification applies to silver ores; decision as to "gold-silver" ore is made arbitrarily on a basis of value, using the rule that the metal of lower value is not used in the bimetal classification unless its value is equal to or over one-quarter of the combined value of gold and silver.

The lead, zinc, and zinc-lead ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver; such ores are excluded from this report.

*Ores produced in the United States and average recovery in fine ounces of gold and silver per ton, 1937–38* [1]

1937

| State | Gold ore | | | Gold-silver ore | | | Silver ore | | |
|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Average ounces per ton | | Short tons | Average ounces per ton | | Short tons | Average ounces per ton | |
| | | Gold | Silver | | Gold | Silver | | Gold | Silver |
| Western States: | | | | | | | | | |
| Arizona | 615,614 | 0.191 | 0.70 | 72,888 | 0.149 | 5.46 | 116,447 | 0.031 | 9.43 |
| California | 4,358,184 | .153 | .23 | 58,058 | .269 | 8.35 | 56,395 | .041 | 17.14 |
| Colorado | 1,291,058 | .235 | .39 | 316,105 | .086 | 1.71 | 74,020 | .004 | 9.43 |
| Idaho | 203,197 | .177 | .52 | 205 | 3.537 | 87.43 | 328,112 | .002 | 43.03 |
| Montana | 644,596 | .202 | .46 | 13,568 | .265 | 14.46 | 246,325 | .028 | 8.03 |
| Nevada | 1,219,732 | .134 | .60 | 382,715 | .080 | 3.78 | 126,601 | .047 | 9.68 |
| New Mexico | 64,682 | .136 | .43 | 68,616 | .160 | 7.34 | 955 | .006 | 10.32 |
| Oregon | 74,400 | .234 | .66 | | | | 1 | | 134.00 |
| South Dakota | 1,597,178 | .363 | .09 | | | | | | |
| Texas | 12 | .333 | | | | | 116,141 | .005 | 11.40 |
| Utah | 216,787 | .220 | 2.53 | 168,769 | .155 | 5.87 | 99,596 | .049 | 19.72 |
| Washington | 179,850 | .200 | .49 | | | | 1,754 | .006 | 10.19 |
| Wyoming | 17 | 9.682 | .76 | | | | | | |
| Total, Western States | 10,465,307 | .202 | .38 | 1,080,924 | .116 | 4.23 | 1,166,347 | .022 | 20.06 |
| Alaska | 4,580,923 | .051 | .03 | | | | | | |
| Eastern States | 60,542 | .138 | .02 | | | | | | |
| | 15,106,772 | .156 | .27 | 1,080,924 | .116 | 4.23 | 1,166,347 | .022 | 20.06 |

See footnotes at end of table.

[4] Except where mineralization approaches a matte, ores in their natural state generally contain more silica than iron and usually are highly siliceous.

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*Ores produced in the United States and average recovery in fine ounces of gold and silver per ton, 1937–38*—Continued

1937—Continued

| State | Copper ore | | | Lead ore | | | Lead-copper ore | | |
|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Average ounces per ton | | Short tons | Average ounces per ton | | Short tons | Average ounces per ton | |
| | | Gold | Silver | | Gold | Silver | | Gold | Silver |
| Western States: | | | | | | | | | |
| Arizona | 19,928,824 | 0.009 | 0.32 | 29,969 | 0.078 | 7.50 | 59 | 0.068 | 13.10 |
| California | 447,248 | .034 | .66 | 5,009 | .065 | 16.54 | | | |
| Colorado | 261,658 | .046 | 15.26 | 30,235 | .262 | 6.77 | 537 | .005 | 21.26 |
| Idaho | 850 | .026 | 43.08 | 412,378 | .002 | 5.00 | | | |
| Montana | 3,426,395 | .004 | 1.94 | 13,867 | .076 | 10.52 | | | |
| Nevada | 5,669,388 | .012 | .05 | 11,218 | .213 | 20.17 | 1,003 | .016 | 6.62 |
| New Mexico | 3,631,454 | .002 | .06 | 1,853 | .075 | 4.80 | 396 | .006 | 13.37 |
| Oregon | 2,796 | .332 | 2.06 | 3 | 5.333 | 15.33 | 30 | 2.300 | 10.67 |
| South Dakota | | | | | | | | | |
| Texas | 3,949 | | .56 | | | | 43 | | .84 |
| Utah | 23,197,017 | .009 | .08 | 152,691 | .069 | 10.69 | | | |
| Washington | 6,631 | .002 | .79 | 445 | | 3.18 | | | |
| Wyoming | | | | | | | | | |
| Total, Western States | 56,576,210 | .009 | .35 | 657,668 | .039 | 6.98 | 2,068 | .045 | 11.84 |
| Alaska | 139,279 | | 2.05 | | | | | | |
| Eastern States | [2] 2,565,535 | .001 | .02 | | | | | | |
| | 59,281,024 | .008 | .34 | 657,668 | .039 | 6.98 | 2,068 | .045 | 11.84 |

| State | Zinc ore | | | Zinc-lead ore | | | Total ore | | |
|---|---|---|---|---|---|---|---|---|---|
| Western States: | | | | | | | | | |
| Arizona | 91 | 0.022 | 0.99 | 212,467 | 0.080 | 3.91 | 20,976,359 | 0.016 | 0.45 |
| California | | | | 120 | .083 | 6.19 | 4,925,014 | .143 | .58 |
| Colorado | 135 | | | 94,871 | .039 | 1.56 | 2,068,619 | .171 | 3.03 |
| Idaho | | | | 1,130,660 | .003 | 2.86 | 2,075,402 | .020 | 9.43 |
| Montana | [3] 125,395 | .002 | .48 | 427,863 | .022 | 5.81 | 4,898,009 | .034 | 2.41 |
| Nevada | 103,305 | .016 | 4.80 | 51,504 | .014 | 8.53 | 7,565,466 | .036 | .64 |
| New Mexico | 170,510 | | | 252,626 | .049 | 1.88 | 4,191,092 | .009 | .30 |
| Oregon | | | | | | | 77,230 | .239 | .72 |
| South Dakota | | | | | | | 1,597,178 | .363 | 09 |
| Texas | | | | | | | 120,145 | .005 | 11.03 |
| Utah | 173 | | | 743,242 | .042 | 7.82 | 24,578,275 | .013 | .52 |
| Washington | | | | 106,146 | | .13 | 294,826 | .122 | .43 |
| Wyoming | | | | | | | 17 | 9.682 | .76 |
| Total, Western States | 399,609 | .005 | 1.39 | 3,019,499 | .026 | 4.45 | 73,367,632 | .039 | .96 |
| Alaska | | | | | | | 4,720,202 | .050 | .09 |
| Eastern States | [4] | | | [5] 363,692 | | .12 | 2,989,769 | .003 | .04 |
| | 399,609 | .005 | 1.39 | 3,383,191 | .023 | 3.99 | 81,077,603 | .038 | .88 |

1938

| State | Gold ore | | | Gold-silver ore | | | Silver ore | | |
|---|---|---|---|---|---|---|---|---|---|
| Western States: | | | | | | | | | |
| Arizona | 698,687 | 0.185 | 0.47 | 137,062 | 0.139 | 6.39 | 92,958 | 0.023 | 10.13 |
| California | 4,386,652 | .160 | .22 | 183,918 | .193 | 7.21 | 9,892 | .015 | 17.10 |
| Colorado | 1,071,562 | .263 | .34 | 379,456 | .103 | 2.49 | 77,640 | .004 | 9.89 |
| Idaho | 283,204 | .142 | .46 | 15,672 | .135 | 5.79 | 444,456 | .002 | 30.60 |
| Montana | 756,223 | .201 | .48 | 7,448 | .293 | 15.69 | 150,930 | .026 | 9.78 |
| Nevada | 1,399,728 | .141 | .42 | 230,783 | .135 | 6.82 | 114,549 | .031 | 11.19 |
| New Mexico | 26,149 | .268 | .75 | 82,017 | .171 | 8.50 | 523 | .009 | 15.24 |
| Oregon | 74,572 | .366 | 1.17 | 351 | .254 | 13.97 | 2 | | 100.00 |
| South Dakota | 1,586,181 | .374 | .10 | | | | | | |
| Texas | | | | | | | 130,923 | .003 | 10.94 |
| Utah | 283,472 | .146 | 1.15 | 184,346 | .134 | 5.70 | 92,543 | .046 | 18.35 |
| Washington | 271,557 | .154 | .47 | 61 | .098 | 8.18 | 7,229 | .010 | 15.30 |
| Wyoming | 580 | .334 | .37 | | | | 1 | | 34.00 |
| Total, Western States | 10,838,567 | .204 | .32 | 1,221,114 | .138 | 5.47 | 1,121,646 | .014 | 19.15 |
| Alaska | 4,767,545 | .049 | .03 | | | | | | |
| Eastern States | 88,671 | .199 | .05 | | | | | | |
| | 15,694,783 | .157 | .23 | 1,221,114 | .138 | 5.47 | 1,121,646 | .014 | 19.15 |

See footnotes at end of table.

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*Ores produced in the United States and average recovery in fine ounces of gold and silver per ton, 1937–38*—Continued

1938—Continued

| State | Copper ore | | | Lead ore | | | Lead-copper ore | | |
|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Average ounces per ton | | Short tons | Average ounces per ton | | Short tons | Average ounces per ton | |
| | | Gold | Silver | | Gold | Silver | | Gold | Silver |
| Western States: | | | | | | | | | |
| Arizona | [6]13,047,356 | 0.010 | 0.35 | 6,072 | 0.173 | 14.44 | 201 | 0.100 | 13.55 |
| California | 66,943 | .034 | .70 | 844 | .504 | 21.95 | | | |
| Colorado | 333,103 | .051 | 16.27 | 19,646 | .336 | 8.61 | 37 | .253 | 9.89 |
| Idaho | 165 | .352 | 8.12 | 272,904 | .003 | 5.31 | | | |
| Montana | 1,607,713 | .003 | 2.40 | 10,574 | .139 | 11.56 | | | |
| Nevada | 4,043,892 | .012 | .11 | 28,325 | .110 | 5.37 | | | |
| New Mexico | 1,904,374 | .003 | .08 | 962 | .201 | 6.50 | 303 | .043 | 37.08 |
| Oregon | 9 | 1.111 | .44 | 2 | 9.000 | 23.00 | | | |
| South Dakota | | | | | | | | | |
| Texas | 70 | | 17.64 | 9 | .059 | 8.56 | | | |
| Utah | 12,032,385 | .008 | .08 | 94,883 | .056 | 11.73 | | | |
| Washington | 373,120 | .082 | .33 | 538 | .004 | 6.16 | | | |
| Wyoming | | | | | | | | | |
| Total, Western States | 33,409,130 | .010 | .46 | 434,759 | .044 | 7.18 | 541 | .078 | 26.46 |
| Alaska | 89,174 | | 2.89 | | | | | | |
| Eastern States | [2]2,341,613 | .001 | .02 | | | | | | |
| | 35,839,917 | .010 | .44 | 434,759 | .044 | 7.18 | 541 | .078 | 26.46 |

| State | Zinc ore | | | Zinc-lead and zinc-copper ores | | | Total ore | | |
|---|---|---|---|---|---|---|---|---|---|
| Western States: | | | | | | | | | |
| Arizona | 160 | 0.206 | 4.53 | 220,668 | 0.069 | 3.24 | [14]14,203,164 | 0.021 | 0.53 |
| California | | | | | | | 4,648,249 | .159 | .55 |
| Colorado | 145 | .082 | .57 | 114,506 | .035 | 2.31 | 1,996,095 | .175 | 3.97 |
| Idaho | | | | 982,746 | .005 | 3.77 | 1,999,147 | .025 | 9.49 |
| Montana | [3]76,809 | | .12 | 114,769 | .032 | 3.92 | 2,724,466 | .062 | 2.35 |
| Nevada | | | | 62,744 | .018 | 5.12 | 5,880,021 | .048 | .74 |
| New Mexico | 182,822 | | | 217,707 | .064 | 1.55 | 2,414,857 | .017 | .51 |
| Oregon | | | | | | | 74,936 | .366 | 1.23 |
| South Dakota | | | | | | | 1,586,181 | .374 | .10 |
| Texas | | | | | | | 131,002 | .003 | 10.94 |
| Utah | 83 | | | 560,948 | .048 | 8.16 | 13,248,660 | .015 | .73 |
| Washington | | | | 249,184 | | .06 | 901,689 | .081 | .42 |
| Wyoming | | | | | | | 581 | .334 | .43 |
| Total, Western States | 260,019 | | .04 | 2,523,272 | .028 | 4.11 | 49,809,048 | .057 | 1.22 |
| Alaska | | | | | | | 4,856,719 | .048 | .09 |
| Eastern States | [4] | | | [5]293,900 | | .13 | 2,724,184 | .007 | .03 |
| | 260,019 | | .04 | 2,817,172 | .025 | 3.70 | 57,389,951 | .054 | 1.07 |

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes magnetite-pyrite-chalcopyrite ore from Pennsylvania yielding copper concentrates carrying gold and silver.
[3] Current slag fumed.
[4] Zinc ore yielded no gold or silver.
[5] Figures cover following States—1937: New York and Tennessee; 1938: New York, North Carolina, and Tennessee.
[6] Includes 1,380,212 tons of ore leached which contained no gold or silver.
[7] Zinc-copper ore came from Arizona only.

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*Mine production of gold in the United States, 1937–38, by States and sources, in fine ounces* [1]

| State | Placers | Dry and siliceous ore | Copper ore | Lead ore | Lead-copper ore | Zinc ore | Zinc-lead and zinc-copper ores [2] | Total |
|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | |
| Alabama | 5 | 2,455 | | | | | | 2,460 |
| Alaska | 393,591 | 234,319 | 30 | | | | | 627,940 |
| Arizona | 4,399 | 131,927 | 176,918 | 2,346 | 4 | 2 | 17,098 | 332,694 |
| California | 472,306 | 686,532 | 15,403 | 327 | | | 10 | 1,174,578 |
| Colorado | 14,871 | 330,361 | 12,015 | 7,920 | 3 | | 3,735 | 368,905 |
| Georgia | 521 | 222 | | | | | | 743 |
| Maryland | | 1,040 | | | | | | 1,040 |
| Idaho | 40,540 | 37,546 | 22 | 913 | | | 2,840 | 81,861 |
| Michigan | | 51 | | | | | | 51 |
| Montana | 36,397 | 140,857 | 14,151 | 1,047 | | 236 | 9,564 | 202,252 |
| Nevada | 9,763 | 200,472 | 66,354 | 2,384 | 16 | 1,639 | 704 | 281,332 |
| New Mexico | 3,027 | 19,740 | 5,858 | 140 | 2 | 2 | 12,402 | 41,171 |
| North Carolina | 7 | 832 | 110 | | | | | 949 |
| Oregon | 34,219 | 17,429 | 929 | 16 | 69 | | | 52,662 |
| Pennsylvania [3] | | | 1,348 | | | | | 1,348 |
| South Carolina | 2 | 2,480 | | | | | | 2,482 |
| South Dakota | 1,011 | 580,533 | | | | | | 581,544 |
| Tennessee | | | 263 | | | | | 263 |
| Texas | | 562 | | | | | | 562 |
| Utah | 55 | 78,630 | 202,427 | 10,540 | | | 31,107 | 322,759 |
| Virginia | 97 | 1,299 | | | | | | 1,396 |
| Washington | 371 | 35,925 | 14 | | | | | 36,310 |
| Wyoming | 1,611 | 165 | | | | | | 1,776 |
| | 1,012,793 | 2,503,377 | 495,842 | 25,633 | 94 | 1,879 | 77,460 | 4,117,078 |
| 1938 | | | | | | | | |
| Alabama | 11 | 30 | | | | | | 41 |
| Alaska | 430,955 | 234,018 | | | | | | 664,973 |
| Arizona | 4,985 | 150,371 | 133,409 | 1,048 | 20 | 33 | 15,177 | 305,043 |
| California | 572,513 | 735,896 | 2,295 | 425 | | | | 1,311,129 |
| Colorado | 18,041 | 321,628 | 17,131 | 6,605 | 9 | 12 | 4,042 | 367,468 |
| Georgia | 578 | 294 | | | | | | 872 |
| Maryland | | 855 | | | | | | 855 |
| Idaho | 54,079 | 43,493 | 58 | 831 | | | 5,052 | 103,513 |
| Montana | 35,348 | 157,906 | 4,965 | 1,471 | | | 3,623 | 203,313 |
| Nevada | 12,959 | 232,199 | 47,024 | 3,108 | | | 1,144 | 296,434 |
| New Mexico | 2,626 | 21,019 | 5,338 | 193 | 13 | | 13,861 | 43,050 |
| North Carolina | 17 | 1,699 | 139 | | | | 23 | 1,878 |
| Oregon | 54,331 | 27,370 | 10 | 18 | | | | 81,729 |
| Pennsylvania [3] | | | 1,422 | | | | | 1,422 |
| South Carolina | 4 | 11,677 | | | | | | 11,681 |
| South Dakota | 1,069 | 593,778 | | | | | | 594,847 |
| Tennessee | | | 236 | | | | | 236 |
| Texas | | 438 | | 1 | | | | 439 |
| Utah | 148 | 70,266 | 98,100 | 5,314 | | | 26,802 | 200,630 |
| Virginia | 57 | 2,886 | | | | | | 2,943 |
| Washington | 1,575 | 41,948 | 30,650 | 2 | | | | 74,175 |
| Wyoming | 604 | 194 | | | | | | 798 |
| | 1,189,900 | 2,647,965 | 340,777 | 19,016 | 42 | 45 | 69,724 | 4,267,469 |

[1] Philippine Islands and Puerto Rico excluded.
[2] Zinc-copper ore in Arizona in 1938 only.
[3] From copper concentrates from magnetite-pyrite-chalcopyrite ore.

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*Mine production of silver in the United States, 1937–38, by States and sources, in fine ounces* [1]

| State | Placers | Dry and siliceous ore | Copper ore | Lead ore | Lead-copper ore | Zinc ore | Zinc-lead and zinc-copper ores [2] | Total |
|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | |
| Alabama | | 457 | | | | | | 457 |
| Alaska | 67,095 | 141,731 | 285,514 | | | | | 494,340 |
| Arizona | 649 | 1,925,271 | 6,439,903 | 224,839 | 773 | 90 | 831,027 | 9,422,552 |
| California | 40,481 | 2,471,112 | 293,065 | 82,864 | | | 743 | 2,888,265 |
| Colorado | 2,565 | 1,744,142 | 4,150,342 | 204,554 | 11,419 | | 147,671 | 6,260,693 |
| Georgia | 23 | 26 | | | | | | 49 |
| Idaho | 12,287 | 14,243,253 | 36,622 | 2,060,761 | | | 3,234,843 | 19,587,766 |
| Illinois [3] | | | | 887 | | | | 887 |
| Maryland | | 40 | | | | | | 40 |
| Michigan | | 8 | 25,446 | | | | | 25,454 |
| Missouri | | | | 179,700 | | | | 179,700 |
| Montana | 6,415 | 2,468,049 | 6,644,653 | 145,828 | | 60,295 | 2,486,853 | 11,812,093 |
| Nevada | 2,531 | 3,396,755 | 297,244 | 226,287 | 6,644 | 495,967 | 439,322 | 4,864,750 |
| New Mexico | 203 | 541,183 | 214,089 | 8,902 | 5,296 | 324 | 473,769 | 1,243,766 |
| New York | | | | | | | 41,500 | 41,500 |
| North Carolina | | 254 | 5,284 | | | | | 5,538 |
| Oregon | 5,024 | 49,406 | 5,768 | 46 | 320 | | | 60,564 |
| Pennsylvania [4] | | | 9,497 | | | | | 9,497 |
| South Carolina | | 624 | | | | | | 624 |
| South Dakota | 75 | 139,563 | | | | | | 139,638 |
| Tennessee | | | 48,207 | | | | 850 | 49,057 |
| Texas | | 1,323,431 | 2,193 | | 36 | | | 1,325,660 |
| Utah | | 3,503,118 | 1,918,080 | 1,632,958 | | | 5,814,961 | 12,869,117 |
| Virginia | 7 | 104 | | | | | | 111 |
| Washington | 48 | 105,325 | 5,257 | 1,414 | | | 14,260 | 126,304 |
| Wyoming | 190 | 13 | | | | | | 203 |
| | 137,593 | 32,053,865 | 20,381,164 | 4,769,040 | 24,488 | 556,676 | 13,485,799 | 71,408,625 |
| 1938 | | | | | | | | |
| Alabama | 1 | 3 | | | | | | 4 |
| Alaska | 63,063 | 158,637 | 258,153 | | | | | 479,853 |
| Arizona | 628 | 2,147,133 | 4,525,435 | 87,700 | 2,724 | 724 | 714,809 | 7,479,153 |
| California | 49,788 | 2,475,476 | 47,016 | 18,524 | | | | 2,590,804 |
| Colorado | 3,250 | 2,073,512 | 5,421,143 | 169,223 | 366 | 83 | 264,518 | 7,932,095 |
| Georgia | 35 | 36 | | | | | | 71 |
| Idaho | 17,328 | 13,820,791 | 1,339 | 1,449,666 | | | 3,704,552 | 18,993,676 |
| Illinois [3] | | | | 576 | | | | 576 |
| Maryland | | 24 | | | | | | 24 |
| Michigan | | | 93,634 | | | | | 93,634 |
| Missouri | | | | 292,000 | | | | 292,000 |
| Montana | 6,534 | 1,956,005 | 3,859,576 | 122,203 | | 9,357 | 450,287 | 6,403,962 |
| Nevada | 3,208 | 3,441,276 | 437,970 | 152,074 | | | 320,943 | 4,355,471 |
| New Mexico | 167 | 725,138 | 150,094 | 6,258 | 11,225 | | 336,978 | 1,229,860 |
| New York | | | | | | | 37,200 | 37,200 |
| North Carolina | | 387 | 4,907 | | | | 206 | 5,500 |
| Oregon | 8,301 | 92,156 | 4 | 46 | | | | 100,507 |
| Pennsylvania [4] | | | 9,360 | | | | | 9,360 |
| South Carolina | 1 | 3,950 | | | | | | 3,951 |
| South Dakota | 82 | 162,213 | | | | | | 162,295 |
| Tennessee | | | 37,476 | | | | 857 | 38,333 |
| Texas | | 1,431,696 | 1,235 | 77 | | | | 1,433,008 |
| Utah | 6 | 3,075,249 | 919,224 | 1,112,585 | | | 4,575,668 | 9,682,732 |
| Virginia | 2 | 413 | 87 | | | | | 502 |
| Washington | 218 | 238,514 | 124,307 | 3,315 | | | 14,584 | 380,938 |
| Wyoming | 79 | 249 | | | | | | 328 |
| | 152,691 | 31,802,858 | 15,890,960 | 3,414,247 | 14,315 | 10,164 | 10,420,602 | 61,705,837 |

[1] Philippine Islands and Puerto Rico excluded.
[2] Zinc-copper ore in Arizona in 1938 only.
[3] From fluorspar-lead ores.
[4] From copper concentrates from magnetite-pyrite-chalcopyrite ore.

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*Gold and silver produced in the United States from ore, old tailings, etc., 1937–38, by States and by methods of recovery* [1]

| State | Total ore, old tailings, etc., treated (short tons) | Ore, old tailings, etc., to gold and silver mills and bullion recovered | | | | Ore and old tailings to concentrating mills (short tons) | Concentrates smelted (from gold and silver and concentrating mills combined) | | | Crude ore to smelters | | | Ore leached, old tailings and slag smelted, etc. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ore (short tons) | Old tailings etc. (short tons) | Gold (fine ounces) | Silver (fine ounces) | | Short tons | Gold (fine ounces) | Silver (fine ounces) | Short tons | Gold (fine ounces) | Silver (fine ounces) | Short tons | Gold (fine ounces) | Silver (fine ounces) |
| 1937 | | | | | | | | | | | | | | | |
| Alaska | 4,720,202 | 4,556,978 | | 201,563 | 37,227 | 153,516 | 28,261 | 30,319 | 299,572 | 9,708 | 2,467 | 90,446 | | | |
| Arizona | 20,976,359 | 431,740 | | 63,484 | 92,405 | 18,203,790 | 669,320 | 110,428 | 3,064,430 | 2,340,829 | 154,359 | 6,264,011 | | 24 | 1,057 |
| California | 4,925,014 | 2,949,474 | 1,279,078 | 546,296 | 938,999 | 672,677 | 54,236 | 147,330 | 1,424,149 | 23,785 | 8,646 | 484,636 | | | |
| Colorado | 2,068,619 | 941,765 | | 200,338 | 78,217 | 801,391 | 78,645 | 124,574 | 1,399,562 | 325,463 | 29,122 | 4,780,349 | | | |
| Idaho | 2,075,402 | 145,056 | | 21,245 | 8,477 | 1,894,447 | 294,953 | 15,127 | 18,578,929 | 35,899 | 4,949 | 988,073 | | | |
| Montana | 4,898,009 | 396,018 | | 63,537 | 120,638 | 4,167,560 | 655,378 | 50,024 | 9,647,795 | 213,536 | 52,294 | 2,016,574 | 120,895 | | 20,671 |
| Nevada | 7,565,466 | 813,980 | 579,153 | 107,303 | 794,101 | 5,906,118 | 314,745 | 100,743 | 1,801,746 | 266,215 | 63,523 | 2,266,372 | | | |
| New Mexico | 4,191,092 | 77,209 | | 8,349 | 258,167 | 4,057,612 | 173,830 | 22,240 | 622,011 | 56,271 | 7,555 | 363,385 | | | |
| Oregon | 77,230 | 14,770 | 3,807 | 2,992 | 959 | 55,191 | 5,646 | 13,430 | 46,214 | 3,462 | 2,021 | 8,367 | | | |
| South Dakota | 1,597,178 | 1,597,178 | | 579,956 | 139,473 | | 123 | 578 | 90 | | | | | | |
| Texas | 120,145 | 110,232 | | 453 | 899,418 | | 806 | 108 | 321,503 | 9,913 | 1 | 104,739 | | | |
| Utah | 24,578,275 | 127,288 | | 11,505 | 4,123 | 23,941,803 | 910,572 | 235,271 | 7,737,160 | 509,184 | 75,928 | 5,127,834 | | | |
| Washington | 294,826 | 142,790 | | 22,619 | 34,611 | 114,566 | 11,536 | 3,933 | 32,313 | 37,470 | 9,387 | 59,332 | | | |
| Wyoming | 17 | 8 | | 62 | 4 | | | | | 9 | 102 | 9 | | | |
| Eastern States | [2] 2,989,769 | 38,617 | | 4,044 | 739 | 2,779,655 | 49,134 | 5,773 | 91,775 | 171,497 | 232 | 14,329 | | | |
| | 81,077,603 | 12,343,103 | 1,862,038 | 1,833,746 | 3,407,558 | 62,748,326 | 3,247,185 | 859,878 | 45,067,249 | 4,003,241 | 410,586 | 22,568,456 | 120,895 | 24 | 21,728 |
| 1938 | | | | | | | | | | | | | | | |
| Alaska | 4,856,719 | 4,733,174 | | 185,208 | 33,126 | 109,846 | 21,036 | 47,567 | 265,358 | 13,699 | 1,243 | 118,306 | | | |
| Arizona | 14,203,164 | 616,544 | | 75,652 | 135,257 | 10,546,807 | 547,519 | 106,505 | 2,817,824 | 1,659,601 | 117,901 | 4,525,444 | 1,380,212 | | |
| California | 4,648,249 | 3,267,534 | 983,955 | 569,627 | 955,017 | 384,010 | 37,902 | 158,662 | 1,314,455 | 12,750 | 10,327 | 271,544 | | | |
| Colorado | 1,996,095 | 991,477 | | 212,016 | 113,963 | 627,298 | 77,893 | 102,704 | 2,017,721 | 377,320 | 34,707 | 5,797,161 | | | |
| Idaho | 1,999,147 | 186,163 | | 16,314 | 8,189 | 1,779,815 | 260,462 | 26,030 | 18,099,795 | 33,169 | 7,090 | 868,364 | | | |
| Montana | 2,724,466 | 510,711 | | 74,251 | 122,112 | 1,976,828 | 353,378 | 34,700 | 4,724,662 | 160,118 | 59,014 | 1,541,297 | 76,809 | | 9,357 |
| Nevada | 5,880,021 | 1,021,304 | 535,071 | 151,916 | 1,380,029 | 4,134,380 | 213,300 | 74,282 | 1,128,755 | 179,266 | 57,277 | 1,843,479 | | | |
| New Mexico | 2,414,857 | 84,057 | | 9,276 | 424,310 | 2,302,992 | 146,061 | 21,199 | 485,661 | 27,808 | 9,949 | 319,722 | | | |
| Oregon | 74,936 | 15,198 | 12,310 | 5,563 | 1,200 | 46,008 | 2,034 | 19,772 | 85,315 | 1,420 | 2,063 | 5,691 | | | |
| South Dakota | 1,586,181 | 1,586,058 | | 590,958 | 161,379 | | 237 | 729 | 170 | 123 | 2,091 | 664 | | | |
| Texas | 131,002 | 127,574 | | 384 | 1,101,131 | | 685 | 55 | 278,056 | 3,428 | | 53,821 | | | |
| Utah | 13,248,660 | 197,936 | | 14,772 | 884 | 12,597,042 | 546,903 | 126,526 | 5,504,390 | 453,682 | 59,184 | 4,177,452 | | | |
| Washington | 901,689 | 212,161 | | 27,500 | 57,893 | 631,864 | 52,335 | 33,549 | 248,414 | 57,664 | 11,551 | 74,413 | | | |
| Wyoming | 581 | 400 | | 77 | 13 | | | | | 181 | 117 | 236 | | | |
| Eastern States | [2] 2,724,184 | 87,615 | | 13,894 | 3,709 | 2,552,140 | 54,834 | 4,152 | 82,048 | 84,429 | 1,215 | 9,149 | | | |
| | 57,389,951 | 13,647,906 | 1,531,336 | 1,947,408 | 4,498,212 | 37,689,030 | 2,314,579 | 756,432 | 37,052,624 | 3,064,658 | 373,729 | 19,606,743 | 1,457,021 | | 9,357 |

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes magnetite-pyrite-chalcopyrite ore from Pennsylvania; excludes ore containing no gold or silver.

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*Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recovered from all sources, 1934–38* [1]

| Year | Bullion and precipitates recovered (fine ounces) | | | | Percent of gold and silver from all sources [1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Amalgamation | | Cyanidation | | Amalgamation | | Cyanidation | | Smelting [2] | | Placers | |
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| 1934 | 866,336 | 250,209 | 503,482 | 1,193,450 | 31.2 | 0.8 | 18.1 | 3.6 | 24.7 | 95.3 | 26.0 | 0.3 |
| 1935 | 928,949 | 433,446 | 610,144 | 1,731,622 | 28.7 | .9 | 18.8 | 3.6 | 28.7 | 95.3 | 23.7 | .2 |
| 1936 | 1,025,040 | 437,091 | 711,366 | 2,518,288 | 27.1 | .7 | 18.8 | 4.1 | 30.2 | 95.0 | 23.9 | .2 |
| 1937 | 1,040,593 | 368,394 | 793,204 | 3,039,172 | 25.3 | .5 | 19.3 | 4.3 | 30.8 | 95.0 | 24.6 | .2 |
| 1938 | 984,620 | 223,058 | 962,788 | 4,275,154 | 23.1 | .4 | 22.6 | 7.0 | 26.4 | 92.4 | 27.9 | .2 |

[1] Philippine Islands and Puerto Rico excluded.
[2] Both crude ores and concentrates.

*Gold and silver produced at amalgamation and cyanidation mills in the United States, 1937–38, by States* [1]

| State | Amalgamation | | | Cyanidation | | | Percent of gold and silver from all sources in State | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ore, old tailings, concentrates, etc., treated (short tons) | Bullion recovered (fine ounces) | | Ore, old tailings, concentrates, sands, slimes, etc., treated (short tons) | Bullion and precipitates recovered | | Amalgamation | | Cyanidation | |
| | | Gold | Silver | | Gold | Silver | Gold | Silver | Gold | Silver |
| 1937 | | | | | | | | | | |
| Alaska | 4,554,648 | 200,671 | 36,367 | 2,374 | 892 | 860 | 31.96 | 7.36 | 0.14 | 0.17 |
| Arizona | 46,654 | 5,167 | 2,393 | 385,086 | 58,317 | 90,012 | 1.55 | .03 | 17.53 | .96 |
| California | 2,442,904 | 370,004 | 214,639 | 2,171,458 | 176,292 | 724,360 | 31.50 | 7.43 | 15.01 | 25.08 |
| Colorado | 673,268 | 71,135 | 15,178 | 606,551 | 129,203 | 63,039 | 19.28 | .24 | 35.02 | 1.01 |
| Idaho | 65,673 | 14,348 | 5,768 | 79,383 | 6,897 | 2,709 | 17.53 | .03 | 8.43 | .01 |
| Montana | 85,039 | 12,955 | 2,682 | 310,979 | 50,582 | 117,956 | 6.41 | .02 | 25.01 | 1.00 |
| Nevada | 486,011 | 27,420 | 19,852 | 1,005,592 | 79,883 | 774,249 | 9.75 | .41 | 28.39 | 15.92 |
| New Mexico | 1,205 | 137 | 30 | 76,004 | 8,212 | 258,137 | .33 | ------ | 19.95 | 20.75 |
| Oregon | 11,590 | 2,231 | 735 | 6,988 | 761 | 224 | 4.24 | 1.21 | 1.45 | .37 |
| South Dakota | 1,414,772 | 329,975 | 66,640 | 1,576,658 | 249,681 | 72,833 | 56.74 | 47.72 | 42.99 | 52.16 |
| Texas | 12 | 4 | ------ | 109,414 | 449 | 896,418 | .71 | ------ | 79.89 | 67.85 |
| Utah | 20,538 | 2,186 | 2,646 | 106,750 | 9,319 | 1,477 | .68 | .02 | 2.89 | .01 |
| Washington | 20,375 | 2,449 | 1,278 | 122,415 | 20,170 | 33,333 | 6.74 | 1.01 | 55.55 | 26.39 |
| Wyoming | 8 | 62 | 4 | ------ | ------ | ------ | 3.49 | 1.97 | ------ | ------ |
| Michigan | 600 | 51 | 8 | ------ | ------ | ------ | 100.00 | ------ | ------ | ------ |
| Eastern States | 17,982 | 1,798 | 174 | 20,635 | 2,246 | 565 | 16.83 | .16 | 21.03 | .53 |
| | 9,841,279 | 1,040,593 | 368,394 | 6,580,287 | 793,204 | 3,039,172 | 25.28 | .52 | 19.27 | 4.27 |
| 1938 | | | | | | | | | | |
| Alaska | 4,731,094 | 183,852 | 33,059 | 2,509 | 1,356 | 67 | 27.65 | 6.89 | .20 | .01 |
| Arizona | 11,177 | 1,706 | 575 | 605,367 | 73,856 | 134,682 | .59 | .01 | 24.87 | 1.80 |
| California | 2,548,159 | 337,514 | 63,930 | 2,382,255 | 232,113 | 891,087 | 25.74 | 2.47 | 17.70 | 34.39 |
| Colorado | 770,788 | 64,157 | 24,114 | 591,197 | 142,859 | 89,849 | 18.82 | .30 | 38.88 | 1.13 |
| Idaho | 72,477 | 13,459 | 6,311 | 113,686 | 2,855 | 1,878 | 13.00 | .03 | 2.76 | .01 |
| Montana | 77,478 | 9,492 | 2,050 | 433,233 | 64,759 | 120,062 | 4.67 | .03 | 31.85 | 1.87 |
| Nevada | 458,485 | 35,151 | 28,901 | 1,171,140 | 116,765 | 1,351,128 | 11.86 | .66 | 39.39 | 31.02 |
| New Mexico | 19,705 | 672 | 136 | 64,352 | 8,604 | 424,174 | 1.56 | .01 | 19.99 | 34.49 |
| Oregon | 6,461 | 2,952 | 608 | 21,193 | 2,611 | 592 | 3.61 | .60 | 3.19 | .59 |
| South Dakota | 1,430,391 | 328,045 | 62,602 | 1,572,566 | 262,913 | 98,777 | 55.15 | 38.57 | 44.20 | 60.86 |
| Texas | ------ | ------ | ------ | 126,889 | 384 | 1,101,131 | ------ | ------ | 87.47 | 76.84 |
| Utah | 7,624 | 381 | 250 | 190,312 | 14,391 | 634 | .19 | ------ | 7.17 | .01 |
| Washington | 2,071 | 439 | 230 | 210,090 | 27,061 | 57,663 | .59 | .06 | 36.48 | 15.14 |
| Wyoming | 400 | 77 | 13 | ------ | ------ | ------ | 9.65 | 3.96 | ------ | ------ |
| Eastern States | 22,229 | 1,633 | 279 | 65,386 | 12,261 | 3,430 | 8.19 | .29 | 61.53 | 3.61 |
| | 10,158,539 | 984,620 | 223,058 | 7,550,175 | 962,788 | 4,275,154 | 23.07 | .36 | 22.61 | 6.97 |

[1] Philippine Islands and Puerto Rico excluded.

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## PLACERS

*Dredging.*—Placer gold is obtained largely from gravels handled by connected-bucket floating dredges, which recovered approximately 62 percent of the total output from placers in the United States (Philippine Islands and Puerto Rico excluded) in 1938 and 64 percent in 1937. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1938 is recorded as 15,822,938 ounces, originating by States as follows: California, 10,049,288 ounces; Alaska, 3,941,308 ounces (including some gold by hydraulicking); Montana, 553,129 ounces; Idaho, 453,067 ounces; Colorado, 420,387 ounces; Oregon, 371,295 ounces; and other States, 34,464 ounces. The output in 1938 was 736,424 ounces from 115 dredges, of which California produced 375,296 ounces from 48 dredges; Alaska, 278,442 ounces from 44 dredges; Idaho, 31,234 ounces from 9 dredges; Montana, 21,356 ounces from 6 dredges; Oregon, 29,006 ounces from 5 dredges; Colorado, 1,027 ounces from 2 dredges; and Nevada, 63 ounces from 1 dredge.

*Connected-bucket floating gold dredges operated in the United States, 1937–38, by companies and districts*

ALASKA

| Company | Address | District | Number of dredges | |
|---|---|---|---|---|
| | | | 1937 | 1938 |
| Alluvial Gold, Inc. | Fairbanks | Circle | 1 | 1 |
| C. J. Berry Dredging Co. | Miller House | do | 1 | 1 |
| Deadwood Mining Co. | Fairbanks | do.[1] | 2 | 1 |
| Gold Placers, Inc. | do | do | 1 | 1 |
| Council Dredging Co. | Council | Council | 1 | 1 |
| Glass Dredging Co. (formerly Straub & Kimball) | do | do | 1 | 1 |
| Inland Dredging Co. | do | do | | 1 |
| North Star Dredging Co. | do | do | 1 | 1 |
| United States Smelting, Refining & Mining Co., Fairbanks Department. | Fairbanks | Fairbanks | 5 | 6 |
| Arctic Circle Explorations, Inc. (formerly Keewalik Mining Co.). | Nome | Fairhaven | 2 | 2 |
| Forsgren Dredging Co. | Deering | do | 1 | 1 |
| Alaska Gold Dredging Corporation | Chicken | Fortymile | 1 | |
| Boundary Dredging Co. | Jack Wade | do | | 1 |
| North American Mines Co., Jack Wade Operations (formerly Jack Wade Dredging Co.). | do | do | 1 | 1 |
| Walker's Fork Gold Corporation | do | do | 1 | |
| Bristol Bay Mining Co. | San Francisco | Goodnews Bay | | 1 |
| American Creek Operating Co. | Fairbanks | Hot Springs | | 1 |
| North American Dredging Co. | Flat | Iditarod | 1 | 1 |
| J. E. Riley Investment Co. | do | do | 1 | 1 |
| Holky Dredging Co. (Ganes Creek Dredging Co. to Oct. 8, 1937). | Ophir | Innoko | 1 | 1 |
| W. F. Puntila | Takotna | do | 1 | 1 |
| Savage & Matheson | do | do | 1 | 1 |
| N. J. Vibe (formerly Felder & Gale) | Ohpir | do | 1 | 1 |
| Fox Bar Dredging Co. | Nome | Kougarok | 1 | 1 |
| Kougarok Consolidated Placers | do | do | 1 | 1 |
| Dime Creek Dredging Co. (Wallace Porter) | Haycock | Koyuk | 1 | 1 |
| Shaw & Cook | Golovin | do | | 1 |
| Ungalik Syndicate | do | do | | 1 |
| Alaska Sunset Mines Corporation | Nome | Nome | 1 | 1 |
| Dry Creek Dredging Co. | do | do | 1 | 1 |
| Greenstone Mines, Inc. | do | do | 1 | |
| Osborn Creek Dredging Co. | do | do | | 1 |
| United States Smelting, Refining & Mining Co., Nome Department. | do | do | 3 | 3 |
| Bartholomae Oil Corporation | do | Port Clarence | 1 | 1 |
| N. B. Tweet & Son | Teller | do | 1 | 1 |
| Casa de Paga Gold Co. | Nome | Solomon | 1 | 1 |
| Lee Brothers Dredging Co. | do | do | 1 | 1 |
| Spruce Creek Dredging Co. | do | do | 1 | |
| New York Alaska Gold Dredging Co. | Nyac | Tuluksak-Aniak | 2 | 2 |
| | | | 41 | 44 |

[1] Fairbanks district in 1937.

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*Connected-bucket floating gold dredges operated in the United States, 1937–38, by companies and districts*—Continued

CALIFORNIA

| Company | Address | District | Number of dredges | |
|---|---|---|---|---|
| | | | 1937 | 1938 |
| Yuba Consolidated Gold Fields | San Francisco | Callahan | 1 | 1 |
| Camanche Placers, Ltd | Camanche | Camanche | 1 | 1 |
| Comanche Gold Dredging Co | San Francisco | do | 1 | 1 |
| Lancha Plana Gold Dredging Co | Camanche | do | 1 | 1 |
| George V. & C. W. Neilsen | do | do | 1 | ------ |
| Wallace Dredging Co | San Francisco | do | 1 | 1 |
| Cosumnes Gold Dredging Co | do | Cosumnes River | 1 | 1 |
| Capital Dredging Co | do | Folsom | 3 | 3 |
| Natomas Co | Sacramento | do | 6 | 7 |
| Sacramento Gold Dredging Co | San Francisco | do | 1 | ------ |
| Cal Oro Dredging Co | do | Greenhorn | 1 | 1 |
| Yreka Gold Dredging Co | do | do | 1 | 1 |
| D. D. Dodson (Staheli) | Red Bluff | Igo | 1 | ------ |
| Roaring River Gold Dredging Co | San Francisco | do | 1 | 1 |
| Arroyo Seco Gold Dredging Co | do | Ione [2] | 2 | 2 |
| Lancha Plana Gold Dredging Co | Camanche | do [3] | 1 | 1 |
| California Gold Dredging Co | San Francisco | Jenny Lind | ------ | 1 |
| Charles James Thompson | Linden | do | ------ | 1 |
| Junction City Mining Co | San Francisco | Junction City | 1 | 1 |
| La Grange Gold Dredging Co | do | La Grange | 1 | 1 |
| Tuolumne Gold Dredging Corporation | La Grange | do | ------ | 1 |
| Lewiston Gold Dredging Co | Lewiston | Lewiston | 1 | 1 |
| Trinity Gold Dredging Co | do | do | 1 | 1 |
| Bill & McCoy Dredging Co | Chico | Magalia | 1 | ------ |
| Antelope Creek Dredging Co | San Francisco | Ophir | 1 | 1 |
| Gold Hill Dredging Co | do | do | 1 | 1 |
| Oro Bell Dredging Co | Berkeley | do | 1 | 1 |
| Oroville Gold Dredging Co | Oroville | Oroville | ------ | 1 |
| Gold Hill Dredging Co | San Francisco | do [4] | 1 | 1 |
| Yuba Consolidated Gold Fields | do | do | 1 | 2 |
| Williams Bar Dredging Co | do | Smartville | 1 | 1 |
| Merced Dredging Co | do | Snelling | 1 | 1 |
| San Joaquin Mining Co | do | do | 1 | 1 |
| Snelling Gold Dredging Co | Snelling | do | 2 | 2 |
| Yuba Consolidated Gold Fields | San Francisco | do | 2 | 2 |
| Yuba Consolidated Gold Fields | do | Yuba River | 5 | 5 |
| | | | 46 | 48 |

COLORADO

| | | | | |
|---|---|---|---|---|
| Timberline Dredging Co | Denver | Beaver Creek | ------ | 1 |
| Continental Dredging Co | Breckenridge | Breckenridge | 1 | 1 |
| | | | 1 | 2 |

IDAHO

| | | | | |
|---|---|---|---|---|
| Fisher-Baumhoff Co | Centerville | Boise Basin | 2 | 2 |
| The Grimes Co | Pioneerville | do | 1 | 1 |
| Moores Creek Dredging Co | Idaho City | do | 1 | 1 |
| Jordan Creek Placers | De Lamar | Carson | 1 | 1 |
| Mount Vernon Mining Co | Orogrande | Elk City, Oro Grande. | 1 | 1 |
| Baumhoff-Fisher Co. (formerly Little Smoky Dredging Co) | Centerville | Little Smoky | ------ | 1 |
| Gold Creek Placer Co | Pierce | Pierce | 1 | ------ |
| Gold Dredging, Inc | do | do | 1 | ------ |
| Warren Dredging Co | Warren | Warren | 1 | 1 |
| Baumhoff-Fisher Co | do | do | 1 | 1 |
| | | | 10 | 9 |

[2] Mother Lode district in 1937.
[3] Lancha Plana district in 1937.
[4] Folsom district until March 11, 1937.



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*Connected-bucket floating gold dredges operated in the United States, 1937–38, by companies and districts*—Continued

MONTANA

| Company | Address | District | Number of dredges | |
|---|---|---|---|---|
| | | | 1937 | 1938 |
| Winston Bros. Co | Helena | Clancey | | 1 |
| Porter Bros. Corporation | do | Helena | 1 | 1 |
| Perry-Schroeder Mining Co | do | Missouri River | | 1 |
| Homer Wilson | Harrison | Norris | 1 | 1 |
| Pioneer Placer Dredging Co | Gold Creek | Pioneer | 1 | 1 |
| Gold Creek Mining Co | Deer Lodge | Washington | | 1 |
| | | | 3 | 6 |

NEVADA

| | | | | |
|---|---|---|---|---|
| Manhattan Gold Dredging Co | Manhattan | Manhattan | | 1 |

OREGON

| | | | | |
|---|---|---|---|---|
| Western Dredging Co | San Francisco | Canyon | 1 | 1 |
| Porter & Co | Helena | Granite | | 1 |
| Rogue River Gold Co | Rogue River | Greenback | 1 | 1 |
| Sumpter Valley Dredging Co | Portland | Sumpter | 1 | 1 |
| Timms Gold Dredging Co | Galena | Susanville | 1 | 1 |
| | | | 4 | 5 |

*Gold produced in the United States by connected-bucket floating dredges, 1934–38, in fine ounces*

| Year | Dredges | California | Alaska | Other States[1] | Total |
|---|---|---|---|---|---|
| 1934 | 74 | 193,773 | 269,082 | 49,940 | 512,795 |
| 1935 | 91 | 236,404 | 216,560 | 53,324 | 506,288 |
| 1936 | 103 | 276,324 | 255,803 | 63,993 | 596,120 |
| 1937 | 105 | 322,961 | 255,568 | 65,614 | 644,143 |
| 1938 | 115 | 375,296 | 278,442 | 82,686 | 736,424 |

[1] Colorado, Idaho, Montana, Oregon, and Nevada.

*Other placer-mining methods.*—From 1932 through 1938 dragline and power-shovel excavators operated in connection with dry-land and floating amalgamating and sluicing plants have been widely used in placer mining. In 1938 approximately 26 percent of the total output of placer gold, including Alaska and excluding the Philippine Islands, was recovered at these plants, and 12 percent was produced by old-established mining methods, such as hydraulicking, drift mining, sluicing, and rocking.

Additional information on placer-mining methods may be found in the State reviews in Minerals Yearbook and Mineral Resources.

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## PRODUCTION IN PHILIPPINE ISLANDS

The value of the gold produced in the Philippine Islands from 1907 to 1938, inclusive, is computed at $155,605,126. The gold production in 1938 was 903,265 ounces valued at $31,614,275 compared with 716,967 ounces valued at $25,093,845 in 1937, an increase of 26 percent. The annual value of the output from 1929 to 1938 was as follows:

*Mine production of gold in the Philippine Islands, 1929–38*

| Year | Gold (fine ounces) | Value [1] | Year | Gold (fine ounces) | Value [1] |
|---|---|---|---|---|---|
| 1929 | 160,620 | $3,320,300 | 1934 | 340,314 | $11,893,975 |
| 1930 | 179,220 | 3,704,800 | 1935 | 451,818 | 15,813,630 |
| 1931 | 182,008 | 3,762,433 | 1936 [2] | 621,968 | 21,768,880 |
| 1932 | 244,298 | 5,050,084 | 1937 [2] | 716,967 | 25,093,845 |
| 1933 | 325,039 | 8,308,009 | 1938 [2] | 903,265 | 31,614,275 |

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67; 1933, $25.56; 1934, $34.95; 1935–38, $35.
[2] Division of Statistics, Department of Agriculture and Commerce, Manila.

The largest producers of gold, in approximate order of importance in 1938 included: Balatoc Mining Co., Benguet Consolidated Mining Co., Antamok Goldfields Mining Co., Itogon Mining Co., Masbate Consolidated Mining Co., I. X. L. Mining Co., San Mauricio Mining Co., United Paracale Mining Co., Coco Grove, Inc., Demonstration Gold Mines, Ltd., Baguio Gold Mining Co., and Suyoc Consolidated Mining Co., each of which produced over 22,000 ounces of gold; in all, they produced about 734,000 ounces. Of the total gold output in 1938, lode mines yielded 853,168 ounces, gravel handled by dredges 34,973 ounces, and other placers 15,124 ounces. Two dredges, each equipped with approximately 80 4-cubic foot buckets, were operated at Paracale, Camarines Norte, by Coco Grove, Inc., and one dredge by Tambis Gold Dredging Co., Inc., at Lianga, Surigao.

The output of silver from the Philippine Islands in 1938 was 1,167,612 ounces, all produced as a byproduct of gold mining.

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# COPPER

By J. W. Furness and H. M. Meyer

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World rates of copper production and consumption in 1938 fell below the records attained in 1937, largely because of the unsatisfactory demand for metal in the United States. Outside of the United States consumption was larger than ever before, being 8 percent above the previous record established in 1937, while that in the United States was 41 percent below 1937 and 54 percent below the previous record consumption in 1929.

Production at domestic mines, primary smelters, and refineries in 1938 failed by about one-third to pace the 1937 rate. Demand for copper was at an extremely low level in the early months of 1938. As a consequence, production was reduced at many properties and was suspended at some others. By July output was at the lowest level of the year, being little more than one-half the rate for January.

Curtailment of output in the middle of the year resulted in bringing new supply below consumption requirements; and stocks, which were 43 percent higher at the end of May than at the beginning of the year, were reduced successively from May to the end of October a total of 103,000 tons. Production increased after July, and following the consumption peak reached in October stocks turned upward again in November and December. Inventories of refined copper at domestic primary refineries were 181,000 tons at the end of 1938 compared with 179,000 tons at the end of 1937, while those of blister and unrefined copper at smelters, in transit to refineries, and at refineries were 233,000 and 214,000 tons, respectively. According to the Copper Institute stocks of refined copper abroad fell from 211,844 tons at the



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end of 1937 to 167,413 at the end of 1938. Foreign stocks declined in every month of the year except June and December. The average monthly rate of consumption abroad was very high all year, but requirements for armament and industry were unable to absorb the increased tonnages available in the final quarter, with the result, already noted, that stocks increased more than 12,000 tons in December.

The unsatisfactory level of consumption in the United States was caused largely by unfavorable industrial conditions in general and particularly by the inability of some large copper-consuming industries, such as the utility industry, to call for even their proportionate share of the total. The failure to find a solution for the problems of the railroads also deterred consumption. The record consumption abroad was due largely to the large amounts needed for armament. Statistics showing how much copper was withdrawn for stock-pile purposes are not available; but it seems safe to assume that Germany and Japan, at least, did not actually consume all the copper made available during the past 2 or 3 years. Consumption for industrial purposes abroad was restricted in several countries because of the urgent needs for military purposes. Despite the record-breaking level of foreign demand in 1937 and 1938 total requirements for copper might have been larger had political uncertainties been removed and industrial uses been permitted to expand.

Because of the better level of consumption in foreign countries in 1938 selling conditions during the year frequently were more favorable in London than in New York; exports of domestic copper were higher than in any other year since 1928 and were about equal to those in that year. According to the Copper Institute, 125,852 tons of duty-free domestic copper were sold abroad in 1938 compared with 62,798 tons in 1937. Total exports of refined copper aggregated 370,545 and 295,064 tons, respectively.

Sales of copper on the Commodity Exchange were larger than ever before as this market assumed increasing importance to the copper industry. In the last 2 months of the year, when the producers' price for copper delivered at Connecticut points was held at 11.25 cents in the face of falling demand, sales on the Commodity Exchange were 3½ times as large as producers' sales, and the discounts amounted to as much as 1 to 1.25 cents a pound. Commodity Exchange sales were 75 percent of those on the London Metal Exchange in 1938.

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*Salient statistics of the copper industry in the United States, 1925–29 (average) and 1935–38, in short tons*

| | Average (1925–29) | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| New copper produced— | | | | | |
| From domestic ores, as reported by— | | | | | |
| Mines | 885,826 | 380,491 | 614,516 | 841,998 | 557,763 |
| Ore produced: | | | | | |
| Copper ore | 59,505,871 | [1] 19,112,054 | [1] 38,514,245 | [1][2] 61,513,148 | [3] |
| Average yield of copper percent | 1.44 | 1.89 | 1.54 | 1.29 | [3] |
| Smelters | 892,730 | 381,294 | 611,410 | 834,661 | 562,328 |
| Percent of world total | 51 | 23 | 32 | 32 | 25 |
| Refineries | 890,767 | 338,321 | 645,462 | 822,253 | 552,574 |
| From foreign ores, matte, etc., refinery reports | 317,287 | 250,484 | 177,027 | 244,561 | 239,842 |
| Total new refined, domestic and foreign | 1,208,054 | 588,805 | 822,489 | 1,066,814 | 792,416 |
| Secondary copper recovered from old scrap only | 347,512 | 361,700 | 382,700 | 408,900 | 267,300 |
| Copper content of copper sulfate produced by refiners | 4,601 | 3,376 | 4,642 | 5,855 | 4,978 |
| Total production, new and old and domestic and foreign | 1,560,167 | 953,881 | 1,209,831 | 1,481,569 | 1,064,694 |
| Imports (unmanufactured) [4] | 391,212 | 257,182 | 190,339 | 279,875 | 252,164 |
| Refined [4] | 59,236 | 18,071 | 4,782 | 7,487 | 1,802 |
| Exports of metallic copper [5] | 522,616 | 295,198 | 259,032 | 346,229 | 421,012 |
| Refined (ingots, bars, rods, etc.) | 482,868 | 275,006 | 236,091 | 310,396 | 385,223 |
| Stocks at end of year | 307,200 | 411,000 | 305,500 | 393,000 | 414,000 |
| Refined copper | 86,100 | 175,000 | 110,000 | 179,000 | 181,000 |
| Blister and materials in solution | 221,100 | 236,000 | 195,500 | 214,000 | 233,000 |
| Withdrawals from total supply on domestic account: | | | | | |
| Total new copper | 778,123 | 441,371 | 656,179 | [6] 694,906 | 406,994 |
| Total new and old copper | 1,288,700 | 890,000 | 1,141,000 | [6] 1,227,000 | 767,000 |
| Price, average cents per pound | 14.7 | 8.3 | 9.2 | 12.1 | 9.8 |
| World smelter production, new copper | 1,761,000 | 1,681,000 | 1,895,000 | 2,583,000 | [7] 2,228,000 |

[1] Includes old tailings.
[2] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[3] Figures not yet available.
[4] Data include copper imported for immediate consumption plus material entering the country under bond.
[5] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper," for which figures of quantity are not recorded.
[6] Revised figures.
[7] Approximate.

Several outstanding developments in the world copper industry during the last decade have had a pronounced effect on the price of copper and in the international trade in this commodity. Perhaps the most important of these has been the remarkable growth in the production of the British Empire to a point where the Empire now has an exportable surplus. Contemporaneous with this expansion there has been a substantial increase in South American production, most of which is controlled by subsidiaries of United States companies. Both sources apparently can produce copper at a cost considerably below the average cost of production in the United States; in consequence, the position formerly enjoyed by domestic producers in the international market, particularly in Great Britain, Germany, and France, has been weakened to a considerable degree. With minor exceptions, exports from the United States, have decreased steadily, and more and more domestic producers are forced to depend on the home market for absorption of their mine output. During 1938, as already has been mentioned, exports from the United States increased materially, but as this was due largely to the abnormal demand abroad for armament it can be considered only a temporary situation.

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The effects of these developments on price have been twofold. First, the competition between relatively low-cost producers in the British Empire and South America has reduced our previous conceptions of normal copper prices by several cents per pound. Secondly, London has replaced New York as the dominant copper market of the world because of the afore-mentioned competition on the London metal exchange. Meanwhile the domestic producer faces the problem of preserving the home market for domestic metal under tariff protection and at the same time of marketing his surplus production abroad at a price that seldom has equaled the New York quotation. This situation has been a disturbing influence in the foreign copper market because exportation of domestic metal when the foreign price is below the domestic creates instability in the London market. Likewise, when the foreign price exceeds the domestic the export of domestic metal not only threatens a shortage in the domestic market but affects prices as well.

Another factor that has had an important influence on world price has been the ever-increasing supply of secondary copper. In the United States the differential between the domestic price of secondary and primary copper is relatively constant because the higher grades of secondary copper are directly competitive with virgin metal in some uses. For example, wire bars may be manufactured from what is known in the scrap trade as No. 1 and No. 2 copper wire and No. 1 heavy copper. In purchasing his raw material the consumer weighs the differential between scrap and virgin against the cost of refurnacing scrap. In consequence, virgin copper prices are very sensitive to changes in scrap prices. The United States leads the world as a source of scrap, and from time to time Japan, Germany, and Great Britain buy large tonnages, usually at a price slightly higher than current domestic prices. These foreign purchases of scrap add another disturbing factor to the domestic price situation.

Chile occupies a unique and powerful position in the international copper trade. The resources of copper in Chile are far greater than those developed so far in either Canada or South Africa and as a matter of fact are larger than the combined total for these two countries. It is evident from the reports published that the Chuquicamata deposit contains more metallic copper than do the combined deposits of Rhodesia and the Congo. The largest mines of Chile are controlled by citizens of the United States, and as these mines can produce copper at a price that cannot be equaled by any group of mines throughout the world on a similar tonnage basis they occupy a strategic position in the industry. Recognizing this, some of the other foreign producers at the time the International Cartel was formed argued that the Chilean output should be considered in the same category with the domestic production of the United States in that it was controlled by the United States and that due to the tariff situation the United States market was closed to all other producers.

Chile's position has effectively blocked the imposition of a British tariff on copper. When this question was discussed at the Ottawa Conference of British Dominions in 1932 a resolution was passed that, at any time the Dominions considered it expedient, a 4-cent duty should be placed upon all copper entering the British Empire other than that produced from British possessions. This tariff has never been applied.

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The fact that United States producers, through their Chilean subsidiaries, could flood the international market at any time with large tonnages of copper produced at a very low figure gives them a trading advantage that unquestionably has been a factor in forestalling the British tariff and has been used to maintain Chile's quota in international trade. Fear of the disastrous competition that would result from collapse of the cartel is the major factor that will preserve it.

The price for copper ordinarily has been subjected to considerable fluctuation, and the greatest sales usually are made on a rising market. This philosophy is diametrically opposed to that of the nickel and aluminum industries, which have attempted to maintain relatively stable prices for their products for many years The theory of these industries is that wide fluctuations of price disturb the channels through which the metal flows to the consumer and that, should prices vary to a great degree, a loss of market would ensue that could not be recaptured without expending large sums of money.

In the metal trades one of the great factors invariably controlling price is substitution, which in many instances is largely a matter of price. In view of the inroads other metals are making in the consumption of copper in transmission lines and other outlets it might well be assumed that in the near future world copper producers will endeavor to meet this competition by further price stabilization.

The Bureau of Mines published a report [1] on the history, geology, prospecting, exploration, development, and mining of copper in North America.

## DOMESTIC PRODUCTION

Statistics on copper production may be compiled on a mine, smelter' or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better for showing the actual recovery of metal and are fairly accurate for showing source of production; and refinery statistics give precise information regarding metal recovered but indicate only in a general way the source of crude materials treated. The chapter on Copper in Mineral Resources of the United States, 1930, contains a discussion of the differences among the three sets of figures.

*Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1934–38, in pounds*

| Year | Mine | Smelter | Refinery |
|---|---|---|---|
| 1934 | 474, 803, 458 | 488, 454, 107 | 466, 058, 360 |
| 1935 | 760, 979, 802 | 762, 587, 340 | 676, 642, 866 |
| 1936 | 1, 229, 030, 719 | 1, 222, 819, 396 | 1, 290, 924, 195 |
| 1937 | 1, 683, 996, 000 | 1, 669, 322, 278 | 1, 644, 505, 129 |
| 1938 | 1, 115, 525, 160 | 1, 124, 656, 539 | 1, 105, 148, 323 |

### PRIMARY COPPER

*Smelter production.*—The recovery of copper by United States smelters from ores of domestic origin totaled 1,124,656,539 pounds in 1938, a decrease of 33 percent from 1937. Smelter domestic output constituted 51 percent of world production in the period 1925–29.

[1] Gardner, E. D., Johnson, C. H. and Butler, B. S., Copper Mining in North America: Bureau of Mines Bull. 405, 1938, 300 pp.

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The proportion dropped sharply in the succeeding years until 1934, when it represented only 17 percent. From then it increased until it reached 32 percent in 1936 and 1937 but declined again to 25 percent in 1938.

The figures for smelter production in 1938 are based on confidential returns from all smelters handling copper-bearing materials produced in the United States. For Michigan, the sum of furnace-refined copper and copper cast into anodes for electrolytic refining is included. The figures for blister represent the fine-copper content. Some casting and electrolytic copper produced direct from ore or matte is included in the smelter production. Metallic and cement copper recovered by leaching is included in smelter production.

The precise quantity, in pounds, of copper produced by smelters in the United States and its value are shown by years for 1845–1930 in the Copper chapter of Mineral Resources of the United States, 1930.

*Copper produced in the United States from domestic ores, 1934–38*

[Smelter output, in pounds fine]

| State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Alabama | 10,972 | 10,061 | 14,293 | 18,820 | |
| Alaska | 130,284 | 14,601,603 | 30,421,557 | 42,215,119 | 33,492,746 |
| Arizona | 168,408,450 | 278,519,397 | 414,144,129 | 580,493,036 | 420,351,310 |
| California | 232,845 | 1,629,735 | 10,327,582 | 10,615,215 | 1,680,754 |
| Colorado | 13,046,759 | 14,340,744 | 19,181,339 | 21,826,209 | 30,563,654 |
| Idaho | 1,717,895 | 2,124,725 | 2,924,763 | 4,804,162 | 5,611,392 |
| Michigan | 51,681,901 | 73,811,562 | 91,105,431 | 84,751,478 | 75,281,469 |
| Missouri | 46,276 | 85,166 | 464,418 | 695,569 | 625,844 |
| Montana | 67,005,217 | 157,760,435 | 215,433,377 | 280,662,270 | 156,249,794 |
| Nevada | 41,922,506 | 72,818,792 | 146,154,075 | 149,963,847 | 93,655,642 |
| New Mexico | 26,994,219 | 4,559,874 | 6,974,705 | 63,573,985 | 43,913,133 |
| North Carolina | (1) | (1) | (1) | (1) | (1) |
| Oklahoma | 10,723 | | | | |
| Oregon | 41,422 | 372,093 | 566,388 | 870,102 | 88,670 |
| Pennsylvania | (1) | (1) | (1) | (1) | (1) |
| South Carolina | 421 | 7,796 | | 136 | 7,893 |
| Tennessee | (1) | (1) | (1) | (1) | (1) |
| Texas | 32,956 | 17,995 | 55,336 | 316,102 | 35,740 |
| Utah | 96,223,463 | 120,972,668 | 261,202,190 | 404,168,742 | 229,876,860 |
| Virginia | 384 | 683 | | 953 | 43,279 |
| Washington | 33,393 | 81,482 | 201,944 | 124,422 | 12,494,297 |
| Wyoming | 3,390 | 1,749 | 42 | 75 | 155 |
| Undistributed | 20,910,631 | 20,870,780 | 23,647,827 | 24,222,036 | 20,683,907 |
| | 488,454,107 | 762,587,340 | 1,222,819,396 | 1,669,322,278 | 1,124,656,539 |

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

*Copper produced (smelter output) in the United States, 1934–38, and total, 1845–1938*

[Values rounded]

| Year | Short tons | Value |
|---|---|---|
| 1934 | 244,227 | $39,076,000 |
| 1935 | 381,294 | 63,295,000 |
| 1936 | 611,410 | 112,499,000 |
| 1937 | 834,661 | 201,988,000 |
| 1938 | 562,328 | 110,216,000 |
| Total, 1845–1938 | 25,876,719 | 7,898,331,000 |

*Mine production.*—The figures for mine production are based on reports furnished to the Bureau of Mines by all domestic mines that produce copper. Details of the method of collecting the statistics

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and reasons for the discrepancy between mine-, smelter-, and refinery-production figures are given in the Copper chapter of Mineral Resources of the United States, 1930.

Mine production is more accurate than either refinery or smelter production for showing the distribution of domestic production by States and districts. It also indicates the production by calendar years more exactly because additional time is required for smelting and refining. Mine production in 1938 was 1,115,525,160 pounds, a decrease of 34 percent over that in 1937 and 37 percent below the average for 1925–29.

*Production by States and districts.*—The following tables show mine and smelter production by States for 1937 and 1938 and by districts for 1934–38. In 1938 Arizona, Utah, and Montana led in production, with 72 percent of the smelter total compared with 76 percent in 1937. If the output of Nevada and Michigan is added to the above, 87 percent of the output of the country is represented compared with 90 percent in 1937. Arizona's proportion of the total increased from 35 percent in 1937 to 37 in 1938. Utah's dropped from 24 to 20 percent, and Montana's fell from 17 to 14. Nevada's proportion was slightly lower than in 1937 while Michigan's share was nearly 2 percent more than the all-time low percentage registered in that year. Of the most important copper-producing States, Arizona, Utah, and Nevada supplied a much larger percentage of the total for 1938 than they did during the period 1845–1938, while Michigan and Montana contributed a much smaller proportion.

*Copper produced in the United States, according to smelter and mine returns, by States, 1937–38, and 1845–1938, in short tons*

| | 1937 | | 1938 | | | 1845–1938, Smelter output | |
|---|---|---|---|---|---|---|---|
| | | | Smelter returns | | Mine returns | | |
| | Smelter returns | Mine returns | Percent of total | Quantity | | Total quantity | Percent of total |
| Alabama | 9 | 4 | | | | (1) | (1) |
| Alaska | 21,108 | 17,336 | 2.98 | 16,746 | 14,549 | 676,472 | 2.62 |
| Arizona | 290,247 | 288,478 | 37.38 | 210,176 | 210,797 | 8,535,965 | 32.99 |
| California | 5,308 | 5,251 | .15 | 840 | 806 | 559,661 | 2.16 |
| Colorado | 10,913 | 10,934 | 2.72 | 15,282 | 14,171 | 239,072 | .92 |
| Idaho | 2,402 | 2,232 | .50 | 2,806 | 2,139 | 81,934 | .32 | |
| Michigan | 42,376 | 47,464 | 6.69 | 37,641 | 46,743 | 4,500,189 | 17.39 |
| Missouri | 348 | 269 | .06 | 313 | | (1) | (1) |
| Montana | 140,331 | 144,528 | 13.89 | 78,125 | 77,213 | 5,723,218 | 22.12 |
| Nevada | 74,982 | 74,603 | 8.33 | 46,828 | 46,169 | 1,229,916 | 4.75 |
| New Mexico | 31,787 | 32,053 | 3.90 | 21,956 | 20,439 | 828,929 | 3.20 |
| North Carolina | (2) | (2) | (2) | (2) | (2) | (1) | (1) |
| Oregon | 435 | 410 | .01 | 44 | 38 | 11,302 | .04 |
| Pennsylvania | (2) | (2) | (2) | (2) | (2) | (1) | (1) |
| South Carolina | (3) | 1 | | 4 | (2) | (1) | (1) |
| Tennessee | (2) | (2) | (2) | (2) | (2) | [4] 259,508 | [4] 1.00 |
| Texas | 158 | 160 | | 18 | 16 | (1) | (1) |
| Utah | 202,084 | 205,994 | 20.44 | 114,938 | 108,126 | 2,935,300 | 11.54 |
| Virginia | (3) | (3) | | 22 | (2) | (1) | (1) |
| Washington | 62 | 64 | 1.11 | 6,247 | 6,017 | 20,720 | .08 |
| Wyoming | (2) | | | | | 15,863 | .06 |
| Undistributed | 12,111 | 12,217 | 1.84 | 10,342 | 10,540 | [5] 208,670 | .81 |
| | 834,661 | 841,998 | 100.00 | 562,328 | 557,763 | 25,876,719 | 100.00 |

[1] Included under "Undistributed"; figures not separately recorded.
[2] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[3] Less than 1 ton.
[4] Approximate production through 1928. Figures for 1929–38 are confidential and are included under "Undistributed."
[5] Includes Tennessee for 1929–38.

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The Bingham (Utah) district again produced more copper than any other district in 1938, followed as in 1937 by Butte, Mont. The Bisbee (Ariz.) district stood third in 1938, having replaced Globe-Miami, Ariz., which held that position in 1937.

Details of mine production, by districts and companies, in 1938, are available in other chapters of this volume dealing with production of gold, silver, copper, lead, and zinc in the various States.

*Mine production of copper in the principal districts,[1] 1934–38, in terms of recovered copper, in short tons*

| District or region | State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Bingham | Utah | 41,793 | 63,060 | 124,453 | 203,421 | 106,049 |
| Butte | Montana | 31,428 | 76,964 | 109,004 | 143,879 | 76,855 |
| Bisbee (Warren) | Arizona | 35,555 | 32,281 | 39,842 | 55,991 | 47,518 |
| Lake Superior | Michigan | 24,108 | 32,054 | 47,984 | 47,464 | 46,743 |
| Globe-Miami | Arizona | 7,161 | 18,680 | 55,668 | 88,509 | 44,528 |
| Ajo | do | [2] | 33,560 | 48,020 | 55,375 | 43,180 |
| Ely (Robinson) | Nevada | 20,467 | 32,815 | 57,580 | 56,706 | 38,501 |
| Yavapai County (mostly Jerome district) | Arizona | 13,199 | 38,086 | 50,327 | 43,403 | 29,437 |
| Pioneer | do | 16,367 | 15,874 | 16,224 | 17,104 | 17,167 |
| Central (including Santa Rita) | New Mexico | 10,895 | 1,547 | 2,213 | 29,464 | 16,557 |
| Ray (Mineral Creek) | Arizona | | 1 | 7 | 17,308 | 15,029 |
| Copper River | Alaska | [3] | [4] 7,750 | [4] 18,850 | [4] 17,336 | [4] 14,549 |
| Red Cliff (Battle Mountain) | Colorado | 4,910 | 6,592 | 7,966 | 9,458 | 12,013 |
| Morenci-Metcalf | Arizona | 6 | 1 | 6 | 6,822 | 11,148 |
| Cope | Nevada | | 3,973 | 12,557 | 16,588 | 6,563 |
| Chelan | Washington | | | | | 5,931 |
| Lordsburg | New Mexico | | 39 | 408 | 1,904 | 3,173 |
| Coeur d'Alene region | Idaho | 736 | 987 | 1,315 | 1,944 | 1,883 |
| San Juan Mountains | Colorado | 585 | 536 | 721 | 1,142 | 1,819 |
| Bunker Hill | Arizona | 2 | 16 | 623 | 1,396 | 1,626 |
| Tintic | Utah | 573 | 882 | 856 | 1,331 | 1,177 |
| Plumas County | California | | 827 | 4,239 | 4,939 | 602 |
| Swain County [5] | North Carolina | [2] | [2] | [2] | [2] | [2] |
| Lebanon (Cornwall mine) [5] | Pennsylvania | [2] | [2] | [2] | [2] | [2] |
| Ducktown [5] | Tennessee | [2] | [2] | [2] | [2] | [2] |

[1] Districts producing 1,000 short tons or more in any year of the period, 1934–38.
[2] Bureau of Mines not at liberty to publish figures.
[3] Total for Alaska was 57 tons in 1934.
[4] Includes a small quantity produced elsewhere in Alaska.
[5] Not listed in order of output.

The following table shows the output of copper in the principal districts in the United States from 1910–38:

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*Mine production of copper in the principal districts in the United States, 1910–38, in terms of recovered copper*

[Includes copper recovered from precipitates]

| Year | Bingham, Utah | | | Silver Bow County, Mont. | | | Globe-Miami, Ariz. | | | Yavapai County, Ariz. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ore and old tailings (short tons) | Copper produced | | Ore and old tailings (short tons) | Copper produced | | Ore and old tailings (short tons) | Copper produced | | Ore and old tailings (short tons) | Copper produced | |
| | | Thousands of pounds | Percent | | Thousands of pounds | Percent | | Thousands of pounds | Percent | | Thousands of pounds | Percent |
| 1910 | 5,427,953 | 113,725 | 1.05 | 4,709,429 | 284,265 | 3.02 | 311,996 | [1] 27,600 | 4.42 | 417,308 | 40,825 | 4.89 |
| 1911 | 6,044,893 | 129,996 | 1.08 | 4,569,942 | 272,271 | 2.98 | 735,345 | 49,010 | 3.33 | 245,165 | 36,104 | 7.36 |
| 1912 | 6,567,948 | 116,622 | .89 | 5,243,935 | 308,223 | 2.94 | 1,449,013 | [2] 61,412 | 2.12 | 406,053 | 34,043 | 4.19 |
| 1913 | 9,190,374 | 144,920 | .79 | 5,612,530 | 285,682 | 2.55 | 1,497,506 | 71,250 | 2.38 | 447,659 | 38,720 | 4.32 |
| 1914 | 7,800,661 | 141,925 | .91 | 4,749,189 | 232,189 | 2.44 | 1,510,593 | 72,895 | 2.41 | 459,982 | 34,058 | 3.70 |
| 1915 | 9,693,184 | 176,593 | .91 | 5,574,105 | 266,006 | 2.39 | 2,569,508 | 102,914 | 2.00 | 614,843 | 59,229 | 4.82 |
| 1916 | 12,777,683 | 223,620 | .88 | 7,209,835 | 349,538 | 2.42 | 7,683,015 | [3] 220,039 | 1.43 | 967,558 | 109,526 | 5.66 |
| 1917 | 14,150,394 | 225,412 | .80 | 5,681,058 | 270,593 | 2.38 | 5,947,681 | [4] 169,417 | 1.42 | 1,176,644 | 159,612 | 6.78 |
| 1918 | 13,607,650 | 211,195 | .78 | 7,394,038 | 321,107 | 2.17 | 7,710,708 | 201,806 | 1.31 | 1,301,828 | 148,883 | 5.72 |
| 1919 | 6,086,379 | 116,697 | .96 | 3,907,089 | 169,053 | 2.16 | 6,280,470 | 171,106 | 1.36 | 738,221 | 80,228 | 5.43 |
| 1920 | 6,067,180 | 110,670 | .91 | 5,013,847 | 176,404 | 1.76 | 7,348,437 | 176,215 | 1.20 | 1,038,243 | 114,937 | 5.54 |
| 1921 | 1,538,309 | 28,011 | .91 | 1,141,013 | 47,958 | 2.10 | 2,870,072 | 76,488 | 1.33 | 191,964 | 26,576 | 6.92 |
| 1922 | 4,745,810 | 91,762 | .97 | 4,010,759 | 165,374 | 2.06 | 6,255,277 | 170,035 | 1.36 | 601,389 | 76,608 | 6.37 |
| 1923 | 11,829,839 | 216,037 | .91 | 5,261,344 | 223,043 | 2.12 | 8,006,991 | 198,426 | 1.24 | 1,594,268 | 147,718 | 4.63 |
| 1924 | 12,708,560 | 236,181 | .93 | 4,192,371 | 247,365 | 2.95 | 8,412,183 | 190,452 | 1.13 | 1,407,479 | 143,348 | 5.09 |
| 1925 | 13,140,350 | 227,612 | .87 | 3,862,401 | 266,637 | 3.45 | 8,500,300 | 175,272 | 1.03 | 1,544,507 | 154,017 | 4.99 |
| 1926 | 14,521,472 | 248,975 | .86 | 3,985,585 | 252,991 | 3.17 | 9,802,958 | 175,386 | .89 | 1,595,826 | 155,368 | 4.87 |
| 1927 | 14,519,121 | 249,919 | .86 | 3,753,246 | 221,312 | 2.95 | 9,760,831 | 171,167 | .88 | 1,575,476 | 141,642 | 4.50 |
| 1928 | 17,251,706 | 287,685 | .83 | 3,896,048 | 247,067 | 3.17 | 9,574,474 | 160,430 | .84 | 1,890,830 | 165,297 | 4.37 |
| 1929 | 18,515,213 | 311,892 | .84 | 4,271,213 | 296,316 | 3.47 | 11,293,656 | 191,596 | .85 | 2,255,441 | 208,172 | 4.62 |
| 1930 | 10,134,900 | 175,070 | .86 | 2,351,836 | 195,472 | 4.16 | 9,740,546 | 158,120 | .81 | 1,395,527 | 117,690 | 4.22 |
| 1931 | 8,485,873 | 147,706 | .87 | 1,869,348 | 184,362 | 4.93 | 7,429,571 | 126,444 | .85 | 431,174 | 44,576 | 5.17 |
| 1932 | 3,465,178 | 62,469 | .90 | 652,967 | 84,608 | 6.48 | 1,994,452 | 28,448 | .71 | 264,213 | 35,809 | 6.78 |
| 1933 | 3,833,509 | 71,636 | .93 | 613,752 | 65,239 | 5.32 | 470 | 259 | 27.55 | 257,125 | 33,258 | 6.47 |
| 1934 | 4,502,819 | 83,586 | .93 | 644,487 | 62,856 | 4.88 | 356,522 | 14,322 | 2.01 | 315,552 | 26,398 | 4.18 |
| 1935 | 7,055,212 | 126,121 | .89 | 1,611,448 | 153,929 | 4.78 | 1,171,101 | 37,359 | 1.60 | 1,078,906 | 76,172 | 3.53 |
| 1936 | 14,258,656 | 248,906 | .87 | 2,796,273 | 218,008 | 3.90 | 5,541,666 | 111,336 | 1.00 | 1,589,843 | 100,654 | 3.17 |
| 1937 | 23,720,375 | 406,842 | .86 | 3,684,972 | 287,757 | 3.90 | 9,734,324 | 177,018 | .91 | 1,579,696 | 86,805 | 2.75 |
| 1938 | 12,507,863 | 212,099 | .85 | 1,623,736 | 153,710 | 4.73 | 4,824,508 | 89,055 | .92 | 1,049,615 | 58,875 | 2.80 |

[1] Smelter production.
[2] Excludes copper in 58,836 tons of old slag.
[3] Excludes copper in 483 tons of old slag.
[4] Excludes copper in 700 tons of old slag.





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*Mine production of copper in the principal districts in the United States, 1910–38, in terms of recovered copper*—Continued

| Year | Bisbee (Warren), Ariz. | | | Ely (Robinson), Nev. | | | Lake Superior, Mich. | | | Central, N. Mex. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ore and old tailings (short tons) | Copper produced | | Ore and old tailings (short tons) | Copper produced | | Ore and old tailings (short tons) | Copper produced | | Ore and old tailings (short tons) | Copper produced | |
| | | Thousands of pounds | Percent | | Thousands of pounds | Percent | | Thousands of pounds | Percent | | Thousands of pounds | Percent |
| 1910 | 1,191,124 | 140,235 | 5.89 | 2,375,032 | 63,914 | 1.35 | 10,869,561 | 222,683 | 1.02 | 37,008 | 2,680 | 3.62 |
| 1911 | 1,095,895 | 128,767 | 5.88 | 2,776,930 | 67,034 | 1.21 | 10,978,827 | 219,840 | 1.00 | 45,584 | 1,413 | 1.55 |
| 1912 | 1,238,408 | 138,703 | 5.60 | 3,023,082 | 67,374 | 1.11 | 11,411,941 | 218,138 | .96 | 1,136,290 | 29,513 | 1.30 |
| 1913 | 1,416,483 | 158,006 | 5.58 | 3,447,812 | 71,917 | 1.04 | 7,016,370 | 135,853 | .97 | 1,948,471 | 51,696 | 1.33 |
| 1914 | 1,401,833 | 151,613 | 5.41 | 2,749,913 | 51,090 | .93 | 9,269,413 | 164,344 | .89 | 1,934,020 | 55,223 | 1.43 |
| 1915 | 1,662,249 | 164,667 | 4.95 | 3,206,133 | 64,662 | 1.01 | 12,334,700 | 265,283 | 1.07 | 2,395,795 | 66,581 | 1.39 |
| 1916 | [5] 1,996,408 | [6] 193,636 | 4.85 | 4,053,950 | 93,045 | 1.15 | 12,364,114 | 273,693 | 1.08 | 3,134,791 | 74,229 | 1.18 |
| 1917 | 1,687,112 | 167,599 | 4.97 | 4,467,709 | 93,627 | 1.05 | 12,400,723 | 255,710 | .99 | 3,668,289 | 82,200 | 1.12 |
| 1918 | 1,632,210 | 160,456 | 4.92 | 4,520,936 | 92,420 | 1.02 | 11,321,365 | 226,794 | .96 | 3,908,816 | 77,547 | .99 |
| 1919 | 1,256,967 | 122,311 | 4.87 | 2,273,961 | 47,871 | 1.05 | 7,690,253 | 178,826 | 1.16 | 1,789,083 | 40,359 | 1.13 |
| 1920 | 1,457,471 | 118,448 | 4.06 | 2,589,546 | 48,348 | .93 | 5,938,967 | 154,695 | 1.30 | 1,882,172 | 44,400 | 1.18 |
| 1921 | 386,929 | 37,249 | 4.81 | 400,810 | 10,283 | 1.28 | 3,610,648 | 86,370 | 1.20 | 362,331 | 9,138 | 1.26 |
| 1922 | 772,482 | 79,591 | 5.15 | 630,871 | 22,615 | 1.79 | 4,952,264 | 121,712 | 1.23 | 1,426,783 | 28,408 | 1.00 |
| 1923 | 1,727,694 | 123,884 | 3.59 | 2,833,674 | 65,928 | 1.16 | 5,363,160 | 138,304 | 1.29 | 2,885,711 | 54,375 | .94 |
| 1924 | 2,547,736 | 140,630 | 2.76 | 3,505,362 | 73,279 | 1.05 | 5,372,572 | 135,663 | 1.26 | 2,859,688 | 66,824 | 1.17 |
| 1925 | 2,529,459 | 145,433 | 2.88 | 3,922,770 | 78,627 | 1.00 | 7,036,751 | 155,157 | 1.10 | 3,159,167 | 68,812 | 1.09 |
| 1926 | 2,520,503 | 140,668 | 2.79 | 4,672,240 | 95,009 | 1.02 | 7,641,682 | 175,382 | 1.15 | 3,633,821 | 75,219 | 1.04 |
| 1927 | [7] | 138,595 | [7] | 4,488,009 | 107,441 | 1.20 | 8,046,334 | 177,538 | 1.10 | 3,087,823 | 66,971 | 1.08 |
| 1928 | 2,395,271 | 161,492 | 3.37 | 5,730,471 | 141,969 | 1.24 | 7,361,658 | 178,443 | 1.21 | 3,723,753 | 80,239 | 1.08 |
| 1929 | 2,796,419 | 186,130 | 3.33 | 6,378,138 | 130,755 | 1.03 | 7,598,180 | 186,402 | 1.23 | 4,135,864 | 87,446 | 1.06 |
| 1930 | 1,978,297 | 127,900 | 3.23 | 3,999,077 | 105,385 | 1.32 | 6,659,036 | 169,381 | 1.27 | 2,667,267 | 57,243 | 1.07 |
| 1931 | 1,186,213 | 95,328 | 4.02 | 2,945,270 | 71,334 | 1.21 | 3,570,748 | 118,059 | 1.65 | 2,714,360 | 56,317 | 1.04 |
| 1932 | 260,284 | 47,405 | 9.11 | 1,374,039 | 30,885 | 1.12 | 1,142,775 | 54,396 | 2.38 | 1,231,876 | 26,513 | 1.08 |
| 1933 | [7] | 55,796 | [7] | 1,220,700 | 28,189 | 1.15 | 697,158 | 46,853 | 3.36 | 1,239,379 | 25,142 | 1.01 |
| 1934 | 521,963 | 71,111 | 6.81 | 1,861,417 | 40,934 | 1.10 | 700,055 | 48,216 | 3.44 | 1,137,259 | 21,790 | .96 |
| 1935 | 600,659 | 64,563 | 5.37 | 2,931,749 | 65,630 | 1.12 | 1,376,803 | 64,109 | 2.33 | 172,561 | 3,095 | .90 |
| 1936 | 844,620 | 79,684 | 4.72 | 4,643,146 | 115,161 | 1.24 | 3,225,600 | 95,968 | 1.49 | 218,468 | 4,427 | 1.01 |
| 1937 | 1,086,259 | 111,983 | 5.15 | 5,565,522 | 113,412 | 1.02 | 4,197,881 | 94,928 | 1.13 | 3,784,450 | 58,929 | .78 |
| 1938 | 919,185 | 95,037 | 5.17 | 3,997,090 | 77,002 | .96 | 3,757,705 | 93,486 | 1.24 | 1,987,688 | 33,114 | .83 |

[5] Excludes 73,657 tons of old slag.
[6] Excludes copper in 73,657 tons of old slag.
[7] Data not available.

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*Quantity and estimated recoverable content of copper-bearing ores.*—The following tables list the quantity and the estimated recoverable copper content of the ore produced by United States mines in 1937; figures for 1938 are not yet available. Of the total copper produced from copper ores in the United States in 1937, 85 percent was obtained from ores concentrated before smelting and 15 percent from direct-smelting ore. No ore was treated by straight leaching in 1937, but 9,724,841 tons were treated by combined leaching and flotation. Straight leaching of copper ores was resumed in 1938. The percentages for 1937 are to be compared with 80 percent obtained from concentrated ore and 20 percent from direct-smelting ores in 1936. Better prices, followed by larger-scale operations and the treatment of lower-grade ores, resulted in the higher ratio of concentrating ores to smelting ores in 1937. It is reasonable to assume that the ratio declined in 1938 with the reversal of 1937 conditions.

Close agreement between the output as reported by smelters and the recoverable quantity as reported by mines indicates that the estimated recoverable tenor is close to the actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. "Copper ores" include not only those that contain 2.5 percent or more copper but also those that contain less than this percentage if they are valuable chiefly for copper. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead and zinc ores, and pyritic sulfur ores.

*Copper ore, old tailings, etc., sold or treated in the United States[1] in 1937, with copper, gold, and silver content in terms of recovered metals*

| State | Ore, old tailings, etc., sold or treated (short tons) | Copper produced | | Gold produced (fine ounces) | Silver produced (fine ounces) | Value of gold and silver per ton of ore |
|---|---|---|---|---|---|---|
| | | Pounds | Percent | | | |
| Arizona | 19,928,824 | [2] 550,186,231 | 1.38 | 176,918 | 6,439,903 | $0.56 |
| California | 447,248 | 9,891,800 | 1.11 | 15,403 | 293,065 | 1.71 |
| Colorado | 261,658 | 19,403,425 | 3.71 | 12,015 | 4,150,342 | 13.88 |
| Idaho | 850 | 145,450 | 8.56 | 22 | 36,622 | 34.23 |
| Michigan | 4,197,881 | 94,928,000 | 1.13 | | 25,446 | |
| Montana | 3,426,395 | [2] 277,430,398 | 4.05 | 14,151 | 6,644,653 | 1.64 |
| Nevada | 5,669,388 | 147,956,900 | 1.30 | 66,354 | 297,244 | .45 |
| New Mexico | 3,631,454 | 61,463,565 | .85 | 5,858 | 214,089 | .10 |
| Oregon | 2,796 | 284,700 | 5.09 | 929 | 5,768 | 13.22 |
| Texas | 3,949 | 272,000 | 3.44 | | 2,193 | .43 |
| Utah | 23,197,017 | [2] 396,990,931 | .86 | 202,427 | 1,918,080 | .37 |
| Washington | 6,631 | 114,731 | .87 | 14 | 5,257 | .69 |
| Eastern States | [3] 739,057 | 24,405,550 | 1.65 | 1,721 | 62,988 | .15 |
| | [1 3] 61,513,148 | [1] 1,583,473,681 | [1] 1.29 | [1] 495,812 | [1] 20,095,650 | [1].53 |

[1] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[2] Excludes copper recovered from precipitates as follows: Arizona, 24,683,500 pounds; Montana, 9,614,024 pounds; and Utah, 4,839,088 pounds.
[3] Includes copper concentrates from pyritiferous magnetite ore from Pennsylvania.

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*Copper ore, old tailings, etc., concentrated [1] in the United States [2] in 1937, with content in terms of recovered copper [3]*

| State | Ore, old tailings, etc., concentrated (short tons) | Concentrates produced (short tons) | Copper produced (pounds) | Percent of copper from ore, etc. |
|---|---|---|---|---|
| Arizona | [1] 17,727,531 | 620,372 | [3] 362,394,062 | 1.02 |
| California | 447,050 | 21,435 | 9,875,300 | 1.10 |
| Michigan | 4,197,881 | 74,086 | 94,928,000 | 1.13 |
| Montana | 3,375,679 | 531,964 | 272,790,057 | 4.04 |
| Nevada | 5,630,634 | 261,130 | 132,755,635 | 1.18 |
| New Mexico | 3,602,172 | 100,829 | 58,992,000 | .82 |
| Utah | 23,194,800 | 592,018 | 396,681,231 | .86 |
| Washington | 6,555 | 235 | 99,893 | .76 |
| Eastern States | [4] 555,620 | 40,897 | 17,176,900 | [5] 1.51 |
| | [3] 58,737,922 | [3] 2,242,966 | [3] 1,345,693,078 | [3] 1.15 |

[1] Includes 9,724,841 tons of copper ore treated by combined leaching and flotation.
[2] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[3] Includes copper from copper ore treated by combined leaching and flotation, 70,878,191 pounds of which were recovered as electrolytic copper.
[4] Pyritiferous magnetite yielding copper concentrates not included with copper ore.
[5] Obtained by including copper concentrates for Pennsylvania and copper ore for other Eastern States.

*Copper ore, old tailings, etc., smelted in the United States [1] in 1937, with content in terms of recovered copper and copper produced from all sources, in terms of recovered copper*

| State | Ore, old tailings, etc., smelted | | | Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds) |
|---|---|---|---|---|
| | Short tons | Copper produced (pounds) | Percent of copper | |
| Alaska | [2] | [2] | [2] | 34,672,000 |
| Arizona | 2,201,293 | 187,792,169 | 4.27 | [3] 576,956,000 |
| California | 198 | 16,500 | 4.17 | 10,502,000 |
| Colorado | 261,658 | 19,403,425 | 3.71 | 21,868,000 |
| Idaho | 850 | 145,450 | 8.56 | 4,464,000 |
| Michigan | | | | 94,928,000 |
| Missouri | | | | 538,000 |
| Montana | 50,716 | 4,640,341 | 4.57 | [3] 289,056,000 |
| Nevada | 38,754 | 15,201,265 | 19.61 | 149,206,000 |
| New Mexico | 29,282 | 2,471,565 | 4.22 | 64,106,000 |
| Oregon | 2,796 | 284,700 | 5.09 | 820,000 |
| Texas | 3,949 | 272,000 | 3.44 | 320,000 |
| Utah | 2,217 | 309,700 | 6.98 | [4] 411,988,000 |
| Washington | 76 | 14,838 | 9.76 | 128,000 |
| Eastern States | 171,395 | 7,228,650 | 2.11 | 24,444,000 |
| | [1] 2,763,184 | [1] 237,780,603 | [1] 4.30 | 1,683,996,000 |

[1] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[2] Bureau of Mines not at liberty to publish figures.
[3] Considerable copper was recovered from precipitates.
[4] Considerable copper was recovered from precipitates and from ores classed as zinc-lead and dry and siliceous ores.

*Copper ores produced in the United States, 1933–37, and average yield in copper, gold, and silver*

| Year | Smelting ores | | Concentrating ores [1] | | Total | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Yield in copper (percent) | Short tons | Yield in copper (percent) | Short tons [1] | Yield in copper (percent) | Yield per ton in gold (ounce) | Yield per ton in silver (ounce) | Value per ton in gold and silver |
| 1933 | 872,033 | 6.30 | 7,475,988 | 1.63 | 8,387,612 | 2.11 | 0.0126 | 0.696 | $0.57 |
| 1934 | 977,096 | 6.21 | 10,681,967 | 1.53 | 11,723,638 | 1.92 | .0124 | .661 | .86 |
| 1935 | [1] 1,612,200 | 5.42 | [2] 17,065,419 | 1.57 | 19,112,054 | 1.89 | .0119 | .664 | .93 |
| 1936 | [1] 2,388,635 | 5.05 | 36,116,692 | 1.31 | 38,514,245 | 1.54 | .0099 | .453 | .70 |
| 1937 | [1] [2] 2,763,184 | 4.30 | [3] 58,737,922 | 1.15 | [3] 61,513,148 | 1.29 | .0081 | .327 | .53 |

[1] Includes old tailings, etc.
[2] Includes old tailings, etc. Exclusive of small quantities from California, which the Bureau of Mines is not at liberty to publish.
[3] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.

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## REFINERY PRODUCTION

The refinery output of copper in the United States in 1938 was made by 10 plants; 8 of these employed the electrolytic method and 2 the furnace process on Lake Superior copper.

There are five large electrolytic refineries on the Atlantic seaboard, three lake refineries on the Great Lakes, and four refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; one at El Paso, Tex.; and one at Clifton, Ariz. Of the above plants the lake refinery of the Quincy Mining Co. and the plant of the Phelps Dodge Corporation that produces furnace-refined copper at Clifton, Ariz., have been idle since 1933.

In addition to the plants mentioned above those at Ajo and Inspiration, Ariz., are equipped to make electrolytically refined copper direct from the liquors obtained from leaching operations; this copper is shipped as cathodes to other refineries, where it is melted and cast into merchant shapes. The Inspiration plant was idle during 1933 and 1934, but operations were resumed during the latter part of 1935. The Ajo plant has been idle since 1931.

The above 14 plants constitute what commonly are termed "regular refineries." Of these plants 10 employ the electrolytic process and 4 the furnace process. The electrolytic plants, excluding the Ajo unit which is no longer active, have a rated capacity of 1,642,000 tons of refined copper per annum. As they produced but 849,000 tons in 1938, only 52 percent of the electrolytic refining capacity was utilized.

The following tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which it is cast.

*Primary and secondary copper produced by regular refining plants in the United States and imported, 1934–38, in pounds*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Primary: | | | | | |
| Domestic:[1] | | | | | |
| Electrolytic | 414,020,483 | [2] 602,826,051 | 1,198,132,177 | [2] 1,548,857,307 | [2] 1,032,976,656 |
| Lake | 51,681,901 | [2] 73,605,212 | 91,105,431 | [2] 84,007,120 | [2] 72,021,341 |
| Casting | 355,976 | 211,603 | 1,686,587 | 11,640,702 | 150,326 |
| | 466,058,360 | 676,642,866 | 1,290,924,195 | 1,644,505,129 | 1,105,148,323 |
| Foreign:[1] | | | | | |
| Electrolytic | 424,523,995 | 500,878,984 | 353,817,802 | 486,285,376 | 479,635,732 |
| Casting and best select | 137,510 | 88,947 | 235,413 | 2,837,298 | 47,674 |
| Refinery production, new copper | 890,719,865 | 1,177,610,797 | 1,644,977,410 | 2,133,627,803 | 1,584,831,729 |
| Imports refined copper[3] | 54,833,436 | 36,142,671 | 9,563,232 | 14,974,815 | 3,603,025 |
| Total new refined copper made available | 945,553,301 | 1,213,753,468 | 1,654,540,642 | 2,148,602,618 | 1,588,434,754 |
| Secondary: | | | | | |
| Electrolytic | 243,189,320 | 296,028,315 | 265,437,556 | [4] 312,831,103 | [4] 185,084,601 |
| Casting | 720,514 | 927,450 | 392,167 | 380,000 | |
| | 243,909,834 | 296,955,765 | 265,829,723 | 313,211,103 | 185,084,601 |
| Grand total | 1,189,463,135 | 1,510,709,233 | 1,920,370,365 | 2,461,813,721 | 1,773,519,355 |

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

[2] Some copper from Michigan was electrolytically refined at an eastern refinery and is included as electrolytic copper.

[3] Data include copper imported for immediate consumption plus material entering the country under bond.

[4] Includes some secondary lake copper.



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*Copper cast in forms in the United States in 1937–38*

| Form | 1937 | | 1938 | |
|---|---|---|---|---|
| | Pounds | Percent | Pounds | Percent |
| Wire bars | 1,295,000,000 | 52.92 | 825,000,000 | 46.61 |
| Cathodes | 555,000,000 | 22.68 | 522,000,000 | 29.49 |
| Cakes | 297,000,000 | 12.14 | 215,000,000 | 12.15 |
| Ingots | 133,000,000 | 5.44 | 88,000,000 | 4.97 |
| Other forms | 167,000,000 | 6.82 | 120,000,000 | 6.78 |
| | 2,447,000,000 | 100.00 | 1,770,000,000 | 100.00 |

Besides the regular refineries, numerous plants throughout the country operate on scrap exclusively, producing metallic copper and a great variety of alloys. The output of these plants is not included in the statements of refined-copper production in the preceding tables but is included in the following statement of secondary-copper production.

*Copper sulfate.*—The production of hydrous copper sulfate or bluestone by copper refineries in the United States was 39,081,407 pounds having a copper content of 9,955,000 pounds in 1938 compared with 45,968,040 pounds having a copper content of 11,709,000 pounds in 1937.

The output of copper sulfate by plants other than the regular primary refineries was 49,819,375 pounds with a reported copper content of 12,565,000 pounds in 1938 compared with 48,538,693 pounds containing 12,235,000 pounds in 1937.

## SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from the treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during the past 5 years. Further details appear in the chapter on Secondary Metals—Nonferrous.

*Secondary copper produced in the United States, 1934–38, in short tons*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Copper as metal | 220,400 | 270,000 | 260,000 | 285,600 | 192,400 |
| Copper in alloys | 157,000 | 178,900 | 224,600 | 246,500 | 167,400 |
| Total secondary copper | 377,400 | 448,900 | 484,600 | 532,100 | 359,800 |
| From new scrap | 66,500 | 87,200 | 101,900 | 123,200 | 92,500 |
| From old scrap | 310,900 | 361,700 | 382,700 | 408,900 | 267,300 |
| Percent of domestic mine output | 159 | 118 | 79 | 63 | 65 |

The production of secondary copper and that by domestic mines decreased similarly in 1938—32 percent and 34 percent, respectively—and in consequence the ratio of secondary to primary was about the same as in 1937. When mine activity was at an extremely low level in 1933 secondary output was 177 percent of mine output; it declined to 63 percent in 1937 and was 65 percent in 1938.

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## CONSUMPTION AND USES

*New supply.*—The total available supply of new copper consists of the total output of primary copper by refineries plus the imports of refined copper; in 1938 it was 1,588,434,754 pounds, a 26-percent decrease from 1937. If this figure is reduced by the quantity of refined copper exported and adjusted for changes in stocks at refineries, the quantity of new copper made available for domestic consumption may be estimated. This computation is made in the table that follows. It should be noted, however, that exports and stocks include some refined secondary copper that cannot be determined separately and that actual consumption of new copper would differ from the figures shown in the table by the changes in consumers' stocks, on which data are not available.

*New refined copper withdrawn from total year's supply on domestic account, 1934–38, in pounds*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Total supply of new copper | 945, 553, 301 | 1, 213, 753, 468 | 1, 654, 540, 642 | 2, 148, 602, 618 | 1, 588, 434, 754 |
| Stock at beginning of year | 813, 000, 000 | 569, 000, 000 | 350, 000, 000 | 220, 000, 000 | 358, 000, 000 |
| Total available supply | 1, 758, 553, 301 | 1, 782, 753, 468 | 2, 004, 540, 642 | 2, 368, 602, 618 | 1, 946, 434, 754 |
| Copper exported [1] | 544, 276, 582 | 550, 012, 320 | 472, 182, 922 | 620, 791, 029 | 770, 446, 945 |
| Stock at end of year | 569, 000, 000 | 350, 000, 000 | 220, 000, 000 | 358, 000, 000 | 362, 000, 000 |
| | 1, 113, 276, 582 | 900, 012, 320 | 692, 182, 922 | [2] 978, 791, 029 | 1, 132, 446, 945 |
| Withdrawn on domestic account | 645, 276, 719 | 882, 741, 148 | 1, 312, 357, 720 | [2] 1,389, 811, 589 | 813, 987, 809 |

[1] Includes refined copper in ingots, bars, rods or other forms.
[2] Revised figures.

As shown in the foregoing table, the quantity of new copper withdrawn on domestic account in 1938 was 41 percent less than in 1937 and 54 percent less than in the record year 1929.

*Total supply.*—Adding 719,600,000 pounds of secondary copper and copper in alloys produced during the year to the 814,000,000 pounds of new refined copper withdrawn on domestic account gives a total supply of 1,533,600,000 pounds of new and old copper available for domestic consumption in 1938. The secondary copper, however, includes remelted new scrap as well as old scrap. The new scrap represents a revolving supply required in manufacturing, so that a more significant figure of supply available for domestic consumption is obtained by adding to the new refined copper only the secondary copper derived from old scrap (534,600,000 pounds). The total available for consumption by this calculation would be 1,348,600,000 pounds in 1938 compared with 2,207,600,000 in 1937 and 2,587,000,000 in 1929.

*Industrial use of copper.*—The American Bureau of Metal Statistics estimates the actual consumption of new and old copper in the United States by uses. Data for the past 5 years are shown in the accompanying table.

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*Estimated use of copper in the United States, 1934–38, in short tons*

| Use | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Electrical manufactures [1] | 101,000 | 128,000 | 164,000 | 212,000 | 150,000 |
| Telephones and telegraphs | 18,000 | 18,000 | 26,000 | 40,000 | 30,000 |
| Light and power lines [2] | 36,000 | 55,500 | 72,000 | 83,000 | 62,000 |
| Wire cloth | 4,600 | 5,600 | 6,500 | 6,800 | 6,000 |
| Other rod and wire [3] | 40,000 | 48,000 | 90,000 | 102,000 | 60,000 |
| Ammunition | 13,500 | 13,700 | 11,900 | 14,100 | 12,500 |
| Automobiles [4] | 63,000 | 95,000 | 108,000 | 112,000 | 55,000 |
| Buildings [5] | 36,000 | 49,000 | 71,000 | 70,500 | 67,500 |
| Castings, n. e. s. [6] | 36,000 | 36,000 | 39,000 | 40,000 | 31,000 |
| Clocks and watches | 2,200 | 2,400 | 3,400 | 4,000 | 3,000 |
| Copper-bearing steel [9] | 2,100 | 2,300 | 3,900 | 4,600 | 2,600 |
| Radiators, heating | 1,000 | 1,100 | 2,000 | 2,100 | 2,000 |
| Radio receiving sets | 12,500 | 16,000 | 24,000 | 23,100 | 17,500 |
| Railway equipment [7] | 2,100 | 1,800 | 4,000 | 7,100 | 1,700 |
| Refrigerators [8] | 15,700 | 15,400 | 15,000 | 13,500 | 6,700 |
| Shipbuilding [8] | 3,200 | 1,100 | 5,000 | 6,400 | 6,000 |
| Air conditioning [8 9] | 3,800 | 4,800 | 6,400 | 7,200 | 6,100 |
| Other uses [10] | 46,800 | 51,500 | 65,300 | 66,600 | 46,200 |
| Manufactures for export | 25,500 | 29,500 | 31,600 | 45,000 | 39,200 |
| | 463,000 | 574,700 | 749,000 | 860,000 | 605,000 |

[1] Generators, motors, electric locomotives, switchboards, light bulbs, etc.
[2] Transmission and distribution wire and busbars; accounting only for the public-utility companies.
[3] Includes industrial wire and cable, wire in buildings, railway cars and ships, radio broadcasting, railway and municipal signaling, railway electrification, trolley wire, rod and wire for Government projects, blasting wire, flexible cord, and sundries.
[4] Does not include starter, generator, and ignition equipment.
[5] Excludes electrical work.
[6] Bearings, bushings, lubricators, valves, and fittings.
[7] Includes air conditioning.
[8] Excludes electrical equipment.
[9] Other than railway.
[10] Includes condenser tubes, oil-burner tubing, welding rod, screw-machine products, nickel-silver and phosphor bronze products, rivets and burrs, toilet pins, eyelets and grommets, electrotyping and engraving sheet, spark plugs, inner-tube valve stems, jar tops and rouge boxes, flashlight tubes, kerosene lamps, kitchen utensils, kitchen-range boilers, linotype matrices, safety razors, blasting caps, asbestos textiles, water meters, thermostats, soldering coppers, yacht fittings, coinage, washing machines, household water heaters, fire extinguishers, etc., all reckoned in terms of copper content.

The foregoing table shows that the use of copper in automobiles in 1938 declined more sharply in relation to 1937 than any other important use for copper; it was 51 percent below 1937 and 60 percent below 1929. The total copper used fell 30 percent from 1937, according to these figures, and was 48 percent lower than in 1929. Although copper used in telephone and telegraph equipment dropped proportionately less than the total for 1938, consumption for this purpose made the poorest showing in relation to 1929, having fallen 82 percent below that year. Light and power lines declined 25 percent in 1938, and other rod and wire fell 41 percent. Government stimulation of the building industry must have been partly responsible for the fact that consumption of copper by this industry held up better than in any other, being only 4 percent below 1937 and 14 percent above 1929.

## STOCKS

The following table gives domestic stocks of copper as reported by primary smelting and refining plants. Stocks of blister copper in transit from smelters to refineries are included under blister copper.

*Stocks of copper in the United States, Jan. 1, 1935–39, in pounds*

| Year | Refined copper | Blister and materials in process of refining | Year | Refined copper | Blister and materials in process of refining |
|---|---|---|---|---|---|
| 1935 | 569,000,000 | 389,000,000 | 1938 | 358,000,000 | 428,000,000 |
| 1936 | 350,000,000 | 472,000,000 | 1939 | 362,000,000 | 466,000,000 |
| 1937 | 220,000,000 | 391,000,000 | | | |

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Stocks of refined copper at refineries were 1 percent higher at the end of 1938 than at the end of 1937; those of blister and unrefined copper at smelters, in transit to refineries, and at refineries were 9 percent higher; and total refined and unrefined stocks increased 5 percent.

Figures of the Copper Institute, quoted in the press, indicated that world stocks aggregated 457,168 short tons at the end of 1938, a 3-percent decrease from the beginning of the year. This decline was due to smaller stocks in foreign countries, where inventories fell from 211,844 to 167,413 tons (21 percent), for stocks of refined, duty-free copper in the United States increased from 259,351 to 289,755 tons (12 percent). These figures do not show the extensive changes during the year. In the United States the excess of production over low domestic requirements in the first 5 months of the year resulted in stocks increasing 43 percent by the end of May. Improved demand and reduced domestic output caused a drop of more than 100,000 tons in inventories by the end of October; then stocks increased. Refined stocks abroad fell from 211,844 tons at the end of 1937 to 155,049 tons at the end of November 1938. They increased 12,364 tons to reach 167,413 at the end of December. According to the Copper Institute, blister stocks gained 5,861 tons in the United States but declined 4,218 tons abroad in 1938. Copper Institute figures for the United States presumably include some metal held by consumers or at some secondary plants, as reports to the Bureau of Mines from primary refineries indicate that stocks of refined copper at refineries, as shown in the foregoing table, were 181,000 tons at the end of 1938 and 179,000 tons at the end of 1937 (compared with 289,755 and 259,351 tons).

Data for consumers' stocks are not available.

## PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 615,000 short tons of copper were delivered to domestic and foreign purchasers in 1938 at an average price (f. o. b. refinery) of 9.8 cents a pound compared with 12.1 cents in 1937 and 9.2 in 1936.

The producers' quotation for copper delivered at Connecticut points was 10.12½ cents at the beginning of 1938. It rose ¾ cent in the early part of January, fell ⅞ cent in the latter part of the month, and declined 1 cent more to 9 cents in May, the lowest price for the year. During the first 5 months of the year demand in the United States was at a very low level, and producers' sales to domestic customers totaled only 22,600 tons or about half the monthly average for all of 1937. During these months domestic output was well ahead of domestic consumption and exports, and large additions to inventories were being made. Announcements in May and June of important reductions in operating rates at domestic mines (already made or to be made), in complete summer shut-downs for some properties, and in a reduction of 10 percent in the rate for the cartel group, resulted in easing of the selling pressure. On June 30 sales of copper totaled 30,954 tons and in the week of June 27–July 2, 118,660 tons, or more than the 112,889 tons sold during the first 5 months of the year. Apparent domestic consumption advanced from May until the high point of the year was reached in October, and stocks of refined copper declined more than 100,000 tons during that period. The price was

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raised 1⅛ cents a pound in July, ¼ cent in September, and ⅞ cent in October to 11.25 cents, the highest quotation for the year. Consumption abroad was at high levels throughout the year, and refined stocks were reduced every month (with one exception) from January through November. War fears are believed to have been largely responsible for the relative scarcity of spot metal abroad in October. The cartel moved quickly in announcing increased production rates in October, in an evident effort to prevent a run-away market, and market tension eased. By October domestic production more than doubled the lowest monthly rate—that for July. Demand declined after October, but production continued to increase and producers' sales to domestic consumers fell to 10,800 tons in November and 15,100 tons in December, the lowest monthly sales reported for the entire year. During the last 2 months of the year domestic refined stocks increased, and in December foreign stocks rose sharply.

For a large part of the year selling conditions abroad were more favorable than in the United States, and exports of domestic copper were maintained at a relatively steady rate throughout the year; in all, they were higher than in any year since 1928. November and December producers' prices were maintained at 11.25 cents a pound in the face of very light sales.

Most of the copper disposed of during November and December was sold on the Commodity Exchange, at discounts of as much as 1–1.25 cents a pound. The importance of this facility for dealing in Standard copper has increased greatly in recent years. Before it was established London was the only large market where copper could be freely traded in, but in recent years activity on the New York Commodity Exchange has permitted the American industry to conduct its hedging operations at home. Sales of Standard copper on the Commodity Exchange were approximately 25 percent of those on the London Metal Exchange in 1936, 50 percent in 1937, and 75 percent in 1938.

*Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, United States, and for spot copper at London, 1937–38, in cents per pound*

| Month | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Domestic f. o. b. refinery [1] | Domestic f. o. b. refinery [2] | Export f. o. b. refinery [2] | London spot [2 3] | Domestic f. o. b. refinery [1] | Domestic f. o. b. refinery [2] | Export f. o. b. refinery [2] | London spot [2 3] |
| January | 12.55 | 12.415 | 12.112 | 12.332 | 10.30 | 10.198 | 9.908 | 10.131 |
| February | 13.46 | 13.427 | 13.828 | 13.985 | 9.87 | 9.775 | 9.525 | 9.759 |
| March | 15.87 | 15.775 | 16.590 | 16.611 | 9.87 | 9.775 | 9.496 | 9.698 |
| April | 15.22 | 15.121 | 14.692 | 14.620 | 9.87 | 9.775 | 9.443 | 9.653 |
| May | 13.87 | 13.775 | 13.999 | 14.044 | 9.47 | 9.375 | 8.801 | 9.059 |
| June | 13.87 | 13.775 | 13.492 | 13.531 | 8.87 | 8.775 | 8.500 | 8.725 |
| July | 13.87 | 13.775 | 13.817 | 13.927 | 9.68 | 9.585 | 9.573 | 9.771 |
| August | 13.87 | 13.775 | 13.926 | 14.145 | 10.00 | 9.900 | 9.844 | 10.003 |
| September | 13.65 | 13.530 | 12.984 | 13.038 | 10.13 | 10.028 | 9.943 | 10.111 |
| October | 11.93 | 11.838 | 11.207 | 11.197 | 10.86 | 10.760 | 10.713 | 10.897 |
| November | 10.90 | 10.797 | 9.850 | 9.819 | 11.12 | 11.025 | 10.569 | 10.735 |
| December | 10.11 | 10.005 | 9.714 | 9.789 | 11.12 | 11.025 | 10.023 | 10.214 |
| Average for year | 13.27 | 13.167 | 13.018 | 13.097 | 10.10 | 10.000 | 9.695 | 9.912 |

[1] As reported by the American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

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*Average yearly quoted prices of electrolytic copper for domestic and export shipment, f. o. b. refineries, United States, and for spot copper at London, 1929–38, in cents per pound*

| | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|---|---|---|
| Domestic f. o. b. refinery [1] | 18.23 | 13.11 | 8.24 | 5.67 | 7.15 | 8.53 | 8.76 | 9.58 | 13.27 | 10.10 |
| Domestic f. o. b. refinery [2] | 18.107 | 12.982 | 8.116 | 5.555 | 7.025 | 8.428 | 8.649 | 9.474 | 13.167 | 10.000 |
| Export f. o. b. refinery [2] | (3) | (3) | (3) | (3) | 6.713 | 7.271 | 7.538 | 9.230 | 13.018 | 9.695 |
| London spot [2 4] | 18.413 | 13.355 | 8.522 | 5.629 | 6.877 | 7.496 | 7.753 | 9.465 | 13.097 | 9.912 |

[1] As reported by the American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Not available, Export quotation was established after imposition of tariff in 1932.
[4] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

## FOREIGN TRADE [2]

United States imports and exports of copper constitute a well-balanced trade through which the smelting, refining, and manufacturing facilities of this country are utilized to treat foreign raw materials and to return refined copper and manufactures of copper abroad. Ninety-nine percent by weight of the copper imported in 1938 was contained in ore, concentrates, and unrefined furnace products. Most of the remainder consisted of ingots to be remelted and recast in the United States. By contrast, 95 percent of the exports comprised refined copper and primary manufactures therefrom.

The United States has long had an exportable surplus of copper and exported more copper than it imported for many years. In 1930–32 imports exceeded exports, and a tariff of 4 cents a pound was placed on copper in 1932. Exports have exceeded imports since that time, and the principal part of imports has been for smelting, refining, and export.

Separation of total exports to show the quantity of domestic copper shipped from the United States is not possible. Data at hand, however, indicate that exports of domestic copper rose sharply in 1938, owing to frequent periods during the year when selling conditions abroad were better than in this country. Excess of total exports over imports of unmanufactured copper rose from 141,000,000 pounds in 1937 to 340,000,000 pounds in 1938. In addition to the copper shown in the accompanying tables an unrecorded quantity of metal is exported in manufactures, such as electrical machinery, automobiles, and similar equipment.

*Imports.*—Imports of all classes of unmanufactured copper except concentrates declined in 1938, the total being 10 percent below 1937. Imports of ore from Chile, Cyprus, and Mexico were sharply lower in 1938 than in 1937. Receipts of copper in concentrates gained in 1938 because of increased quantities from Mexico, Canada, and Cuba, for those from other important sources declined. More unrefined copper was received from Canada and Turkey in 1938 than in 1937, but the decline in imports from Chile, Mexico, and Yugoslavia more than offset the increase from those countries. Imports of refined copper from Chile dropped sharply in 1938.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Copper (unmanufactured) imported into the United States in 1938, in pounds*[1]

| Country | Ore (copper content) | Concentrates (copper content) | Regulus, black or coarse copper, and cement copper (copper content) | Unrefined black blister and converter copper in pigs or converter bars | Refined in ingots, plates, or bars | Old and scrap copper, fit only for remanufacture, and scale and clippings |
|---|---|---|---|---|---|---|
| Africa: | | | | | | |
| British: | | | | | | |
| Union of South | | 524,579 | 2,186 | 3,315,531 | | |
| Other South | | 395,180 | | 8,511,346 | | |
| Argentina | 102,505 | | 55,810 | | | 533,483 |
| Australia | 694,200 | 3,523,713 | 712,196 | | | 4,621 |
| Bolivia | 450,126 | 4,782,588 | 565 | | | |
| Canada | 1,081,168 | 49,591,580 | 2,622,920 | 33,346,397 | 32,246 | 1,065,179 |
| Chile | 6,258,821 | 2,866,356 | 47,555 | 122,105,569 | 3,570,520 | 619,795 |
| Cuba | 112,446 | 34,528,499 | | 722,898 | | 317,902 |
| Malta, Gozo, and Cyprus Islands | 2,858,240 | | | | | |
| Mexico | 1,736,290 | 11,735,317 | 18,930 | 80,792,612 | | |
| Newfoundland and Labrador | | 13,160,455 | | | | |
| Peru | 1,633,185 | 184,082 | 132,416 | 78,300,553 | | |
| Philippine Islands | 500 | 2,320,179 | 318,768 | 15,365 | | |
| Turkey | | | | 5,087,752 | | |
| United Kingdom | | | 283,776 | 219,213 | 259 | 23,708 |
| Yugoslavia | | | | 21,164,326 | | |
| Other countries | 31,900 | 892,303 | 843,704 | 15,000 | | 60,466 |
| | 14,969,381 | 124,504,831 | 5,038,826 | 353,596,562 | 3,603,025 | 2,625,154 |

[1] Data include copper imported for immediate consumption plus material entering the country under bond.

*Copper (unmanufactured) imported*[1] *into the United States, 1934–38*

| Year | Pounds | Year | Pounds |
|---|---|---|---|
| 1934 | 426,571,568 | 1937 | 559,749,133 |
| 1935 | 514,364,526 | 1938 | 504,327,779 |
| 1936 | 380,677,700 | | |

[1] Data include copper imported for immediate consumption plus material entering the country under bond.

*Exports.*—Exports of all classes of copper totaled 844,027,426 pounds in 1938, an increase of 20 percent over 1937, and were the largest since 1929; they amounted to 80 percent of the average for 1925–29. The gain in total shipments of copper abroad is explained mainly by the largely increased exports of refined copper (the principal class of exports) to countries that were either at war or anticipating war—Germany, Japan, Czechoslovakia, and Poland—for exports to other large customers, such as the United Kingdom and France, dropped. Germany received the principal part of the old and scrap copper exported, about the same quantity as in 1937, while Japan's imports of this class fell sharply.

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*Copper exported from the United States in 1938,[1] in pounds*

| Country | Ore, concentrates, composition metal, and unrefined copper (copper content) | Refined | | Old and scrap | Pipes and tubes | Plates and sheets | Wire (except insulated) | Insulated wire and cable | Other copper manufactures |
|---|---|---|---|---|---|---|---|---|---|
| | | Bars, ingots, or other forms | Rods | | | | | | |
| Argentina | | 5,027,540 | 545 | | 73,535 | 25,051 | 154,650 | 720,838 | |
| Belgium | 1,180,927 | 18,349,877 | 841,632 | 1,439,900 | 292 | | 2,006 | 72,144 | |
| Brazil | | 3,478,531 | 484,364 | | 171,941 | 21,724 | 259,817 | 522,305 | |
| Canada | 4,300 | 1,563,120 | 865,373 | 75,337 | 274,905 | 114,185 | 28,392 | 541,688 | |
| China | | 951,964 | 68 | 67,196 | 8,065 | 11,698 | 3,254,114 | 193,104 | |
| Cuba | | 23,208 | 18,851 | | 213,273 | 58,881 | 227,285 | 1,580,996 | |
| Czechoslovakia | | 66,827,737 | | 2,697,506 | | | 14,502 | 1,618 | |
| Denmark | | 2,590,561 | 2,690,870 | | | | | 7,195 | |
| France | | 64,221,367 | 1,293,271 | 4,008,155 | 2,007 | 25,245 | 730,184 | 25,930 | |
| Germany | 85,224 | 148,665,920 | | 23,678,355 | 203 | | 22,429 | 26,050 | |
| Hong Kong | | 5,717,568 | | | 107 | 651 | 1,536,748 | 239,479 | |
| India, British | | 1,306,346 | 3,571,643 | 210,008 | 4,984 | 68,847 | 5,492 | 167,572 | (2) |
| Italy | | 43,747,205 | | 2,639,365 | | 19,309 | 60,373 | 668 | |
| Japan | | 217,879,738 | | 3,804,560 | 1,203 | 22,612 | 242,551 | 2,221 | |
| Mexico | 191,935 | 2,038,091 | 4,963 | 60,510 | 179,865 | 71,509 | 184,091 | 576,758 | |
| Netherlands | 197,956 | 13,780,116 | 3,342,717 | 3,292,728 | 9,225 | 65,027 | 7,526 | 24,125 | |
| Norway | | 1,381,680 | 4,837,896 | 33,676 | 6,524 | | 4,313 | 5,155 | |
| Philippine Islands | 8,357 | 1,317,673 | 5,420 | | 50,183 | 25,581 | 176,639 | 2,550,160 | |
| Poland and Danzig | | 24,912,966 | | 245,807 | | | | 145 | |
| Spain | | | | 22,058 | | | | 3,350 | |
| Sweden | | 37,250,260 | 811,213 | 672,274 | 2,141 | | | 18,502 | |
| U. S. S. R. | | 110,359 | | | 557 | | | 198 | |
| United Kingdom | 335,530 | 61,230,901 | 145,398 | 533,366 | 7,618 | 37,820 | 7,211 | 82,784 | |
| Other countries | | 18,717,953 | 10,442,040 | 140,545 | 638,176 | 531,450 | 3,805,272 | 7,123,932 | |
| Total value | 2,004,229<br>$171,878 | 741,090,681<br>$74,062,534 | 29,356,264<br>$3,127,467 | 43,621,346<br>$3,574,504 | 1,644,804<br>$355,368 | 1,099,590<br>$224,466 | 10,723,595<br>$1,285,951 | 14,486,917<br>$3,317,680 | (2)<br>$689,008 |

[1] Changes in table in Minerals Yearbook, 1938, p. 98, are as follows: Bars, ingots and other forms exported to Czechoslovakia should read 11,344,092 pounds; Germany, 75,070,191 pounds; Italy, 41,624,043 pounds; Poland and Danzig, 7,374,538 pounds; total, 590,127,046 pounds; value, $76,684,278.

[2] Figures for quantity not recorded.

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*Copper [1] exported from the United States, 1934–38*

| Year | Pounds | | Total value | Year | Pounds | | Total value |
|---|---|---|---|---|---|---|---|
| | Metallic [2] | Total | | | Metallic [2] | Total | |
| 1934 | 592, 718, 891 | 625, 485, 074 | $49, 263, 566 | 1937 | 692, 458, 087 | 700, 633, 621 | $92, 774, 770 |
| 1935 | 590, 396, 106 | 605, 746, 050 | 48, 363, 303 | 1938 | 842, 023, 197 | 844, 027, 426 | 86, 119, 848 |
| 1936 | 518, 064, 333 | 524, 833, 536 | 50, 077, 631 | | | | |

[1] Exclusive of "Other copper manufactures" valued at $500,974 in 1934, $570,061 in 1935, $585,568 in 1936, $851,697 in 1937, and $689,008 in 1938, quantity not recorded.
[2] Exclusive of ore, concentrates, and composition metal. Exclusive also of unrefined copper, figures for which are not separable from those for ore and concentrates.

*Copper sulfate (blue vitriol) exported from the United States, 1934–38*

| Year | Pounds | Value | Year | Pounds | Value |
|---|---|---|---|---|---|
| 1934 | 3, 858, 620 | $128, 756 | 1937 | 23, 528, 240 | $1, 212, 430 |
| 1935 | 4, 508, 271 | 142, 467 | 1938 | 31, 249, 735 | 1, 229, 317 |
| 1936 | 10, 734, 408 | 342, 847 | | | |

*Brass and bronze exported from the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Pounds | Value | Pounds | Value |
| Ingots | 478, 311 | $70, 755 | 236, 061 | $24, 186 |
| Scrap and old | 37, 102, 665 | 3, 198, 552 | 31, 976, 834 | 2, 295, 074 |
| Bars and rods | 16, 023, 309 | 2, 267, 969 | 2, 311, 072 | 411, 417 |
| Plates and sheets | 871, 415 | 234, 521 | 1, 098, 504 | 242, 206 |
| Pipes and tubes | 2, 722, 099 | 705, 755 | 1, 385, 065 | 310, 903 |
| Pipe fittings and valves | 2, 697, 113 | 1, 706, 592 | 1, 971, 222 | 1, 256, 571 |
| Plumbers' brass goods | 1, 274, 944 | 679, 384 | 997, 044 | 575, 691 |
| Wire of brass or bronze | 656, 424 | 185, 558 | 367, 305 | 103, 831 |
| Brass wood screws | (1) | 47, 572 | (1) | 23, 742 |
| Hinges and butts of brass or bronze | (1) | 75, 950 | (1) | 57, 883 |
| Other hardware of brass or bronze | (1) | 367, 703 | (1) | 248, 932 |
| Other brass and bronze manufactures | (1) | 1, 926, 576 | (1) | 2, 394, 411 |
| | | 11, 466, 887 | | 7, 944, 847 |

[1] Weight not recorded.

*Unmanufactured brass exported from the United States, 1934–38*

[Ingots, bars and rods, and plates and sheets]

| Year | Pounds | Value | Year | Pounds | Value |
|---|---|---|---|---|---|
| 1934 | 1, 855, 305 | $327, 685 | 1937 | 17, 373, 035 | $2, 573, 245 |
| 1935 | 2, 329, 353 | 382, 681 | 1938 | 3, 645, 637 | 677, 809 |
| 1936 | 2, 712, 758 | 462, 535 | | | |

## SMELTING AND REFINING

One of the present-day trends in reverberatory smelting is definitely toward high-tonnage operations, according to Honeyman.[3] At the Phelps Dodge Corporation Douglas (Ariz.) plant, the reconstructed 107- by 26-foot reverberatory furnaces are operated at the rate of 1,000 tons of solid charge a day. The arch, all of silica brick, is high enough above the bath to give ample combustion space within the furnace.

[3] Honeyman, P. D. I., Metallurgy of Copper: Min. and Met., vol. 20, No. 385, January 1939, p. 19.

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At Noranda high tonnages—up to 1,500 tons of solid charge per furnace day—were reported smelted in reverberatories. Use of the suspended magnesite arch continues at this plant. At both the Douglas and United Verde smelters of Phelps Dodge extensive use is being made of C. R. Kuzell's method of hot-patching the inside of silica arches of reverberatories without interfering with furnace operation. The method consists of building up and renewing worn areas in the refractory surfaces by spraying on an aqueous suspension of finely divided particles of refractory material.

The design of the new Nevada Consolidated Copper Corporation smelter at Hurley, N. Mex., is much like that for the company's revamped smelter at McGill, Nev. At McGill the reverberatory is of the wet-charge type, the charge material being distributed along the furnace by vibrating conveyors. Use of the wet charge makes possible virtual elimination of dust, and this practice will be used at Hurley.

According to Boggs,[4] Tennessee Copper Co.'s principal source of revenue is from sulfuric acid and iron; consequently, its copper metallurgy is passing through a slow process of change from the old method of smelting ore directly in blast furnaces to all-milling selective flotation. When the article was written only one small blast furnace was in operation. Boggs said that it was to be replaced in the near future, probably with a coal-fired reverberatory or an electric furnace.

New developments in connection with electric smelting include improved practice in building large electric furnaces of a size more nearly comparable with that of reverberatories. According to Sem,[5] the new methods that have been developed lately for utilization of sulfur dioxide in smelter gases have made it desirable—in many instances necessary—to utilize the gases. The economic possibility, however, depends to a great extent on concentration of sulfur dioxide in the gases. He claims that a high concentration in gas is possible only in an electric smelting furnace where the gas is not diluted with gases of combustion.

Several articles on copper refining, published recently, are of general interest.[6]

## WORLD ASPECTS OF COPPER INDUSTRY

*International cooperation.*—During 1938 the flexibility of the copper-restriction scheme was proved. As the year began, foreign producers who are members of the cartel were operating at 105 percent of their agreed production capacities. These capacities, incidentally, do not represent actual production capacities but are merely bases for the regulation of operating rates. Foreign demand was well maintained throughout the year, and foreign visible refined stocks declined almost steadily, but the reverse of these conditions prevailed in the domestic market. The unsatisfactory situation in the United States and the large exportation of United States copper contributed to the midyear weakness in European price. The cartel took steps to protect the position of the foreign market by reducing output 10 percent,

[4] Boggs, W. B., Copper Metallurgy Improvements Limited: Engineering and Mining Journal, vol. 140, No. 2, February 1939, p. 77.

[5] Sem, M., Electric Smelting With the Westly Furnace: Eng. and Min. Jour., vol. 140, No. 1, January 1939, pp. 47–48.

[6] Clark, C. W., Refining of Copper: Canadian Metals and Metallurgical Ind., vol. 1, No. 4, April 1938, pp. 113–116.
The Mining Journal (London), Copper Refining at Prescott: Vol. 201, No. 5359, May 7, 1938, pp. 452–455.
Engineering and Mining Journal, Rhokana Refines Copper at Nkana: Vol. 140, No. 1, January 1939, pp. 42–43.

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or to 95 percent of agreed capacities, effective July 1. Smaller domestic and foreign production and increased consumption marked the third quarter of the year, and by October a tight situation developed regarding foreign supplies, partly or largely caused by war fears. In an evident effort to prevent a run-away market, the foreign group in October, announced two step-ups in production rates—to 105 percent of capacity and to unrestricted production. The largely increased tonnages made available, combined with a reversal of the uptrend of consumption, caused the cartel members to announce resumption of production restriction to 110 percent of capacity, effective January 1, 1939. Before this rate was obtained, it was deemed advisable to cut the output rate to 105 percent for December 15 to 31 and to 100 percent at the beginning of 1939. The rapid changes in cartel rates of activity in the last quarter of 1938 would seem to indicate that the group is more interested than formerly in short-time trends.

The following table, published in the annual review of Brandeis, Goldschmidt & Co., Ltd., for 1938, shows clearly the spread between capacities agreed upon for calculating production quotas and estimated full capacities.

*Calculated basic production capacities, highest monthly outputs, and estimated full capacities of the chief properties operating under the restriction scheme, in long tons*

| Producer | Agreed capacity at 100 percent | Highest monthly output | Estimated full capacity |
|---|---|---|---|
| Chile Copper Co | 145,000 | 19,000 | 220,000 |
| Andes Copper Co | 30,000 | 7,000 | 100,000 |
| Braden Copper Co | 117,000 | 13,000 | 160,000 |
| Rhodesian producers | 202,000 | 19,000 | 280,000 |
| Katanga | 112,000 | 17,000 | 200,000 |
| | 606,000 | 75,000 | 960,000 |

*World production.*—Mining and smelting of copper in the world are concentrated in the United States, Chile, Canada, Northern Rhodesia, Belgian Congo, U. S. S. R., and Japan. The United States predominates in copper refining by a much wider margin and is followed in importance by Chile, Germany, Canada, Great Britain, and Belgium.

World smelter production of copper fell 14 percent below the high record of 1937 but, except for that year, was the highest ever attained. As the output from domestic materials at plants in the United States was about one-third below 1937, the high level of world production in 1938 is explained by nearly record operations abroad. Of the important copper-producing countries Canada and Northern Rhodesia produced more copper than ever before; but output in Northern Rhodesia, at least, lagged considerably behind capacity operations. Chile's smelter production decreased 15 percent, but mine output only 10 percent. Belgian Congo's smelter total was 18 percent below 1937. The below-capacity production in Northern Rhodesia and the drop in Chile and Belgian Congo were due to restricted activity agreed on by cartel members. The strenuous efforts of countries like Germany, U. S. S. R., and Japan to become more nearly self-sufficient in supplies of copper made little headway in 1938. Output in U. S. S. R. increased; eventually this country will supply all of its own needs and have an exportable surplus of metal, but its program lags behind Government plans, and a large import balance continues.

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*World mine and smelter production of copper, 1936–38, in metric tons*

[Compiled by M. T. Latus]

| | Mine | | | Smelter | | |
|---|---|---|---|---|---|---|
| | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 |
| North America: | | | | | | |
| Canada | 190,974 | 240,416 | 265,813 | [1] 173,412 | [1] 210,024 | [1] 222,730 |
| Cuba | 11,163 | 13,191 | 14,431 | | | |
| Mexico | 29,713 | 46,077 | 41,851 | 32,623 | 45,755 | 41,425 |
| Newfoundland | 5,336 | 8,463 | 8,056 | | | |
| Panama | 22 | 3 | | | | |
| United States | 557,566 | 763,844 | 505,991 | [2] 592,645 | [2] 820,333 | [2] 570,773 |
| | 794,774 | 1,071,994 | 836,142 | 798,680 | 1,076,112 | 834,928 |
| South America: | | | | | | |
| Bolivia | [3] 3,249 | [3] 3,699 | [3] 2,885 | | | |
| Chile | 256,209 | 413,010 | 371,370 | 244,699 | 396,461 | 337,508 |
| Peru | 33,352 | 36,649 | 37,750 | 32,768 | 35,439 | 35,969 |
| | 292,810 | 453,358 | 412,005 | 277,467 | 431,900 | 373,477 |
| Europe: | | | | | | |
| Belgium | | | | [4] 58,770 | [4] 90,260 | ([5]) |
| Bulgaria | 2 | 16 | 64 | | | |
| Czechoslovakia | ([5]) | ([5]) | ([5]) | 1,103 | 2,013 | ([5]) |
| Finland | 11,391 | 12,032 | 12,232 | 6,636 | 10,545 | 11,824 |
| France | 531 | 591 | [6] 600 | 1,099 | ([5]) | ([5]) |
| Germany | 26,906 | 27,129 | ([5]) | [7] 61,600 | [7] 65,500 | [7] 70,000 |
| Austria | 12 | 12 | ([5]) | 1,800 | 2,071 | |
| Greece | | 300 | ([5]) | | | |
| Hungary | 116 | 1,216 | ([5]) | | | |
| Italy | 603 | 610 | ([5]) | 469 | 1,465 | 2,933 |
| Norway | 22,607 | 20,075 | ([5]) | 8,365 | 8,302 | ([5]) |
| Portugal | [6] 2,000 | [6] 2,000 | [6] 2,000 | | | |
| Rumania | [8] 645 | [8] 1,361 | ([5]) | 645 | 1,361 | ([5]) |
| Spain | [6] 30,000 | [6] 28,000 | [6] 30,000 | [6] 10,100 | [6] 10,200 | [6] 12,000 |
| Sweden | 8,103 | 7,174 | ([5]) | 9,547 | 9,093 | ([5]) |
| U. S. S. R.[9] | [10] 82,999 | [10] 94,250 | [10] 114,552 | 82,999 | 94,250 | 114,552 |
| United Kingdom | 63 | 37 | ([5]) | 9,499 | 7,519 | ([5]) |
| Yugoslavia | 39,600 | 42,300 | 49,500 | 39,400 | 39,410 | 41,993 |
| | 226,000 | 237,000 | ([5]) | 292,032 | 342,000 | ([5]) |
| Asia: | | | | | | |
| Burma | 4,100 | 3,800 | ([5]) | | | ([5]) |
| China [11] | | ([12]) | 240 | | ([12]) | 240 |
| Cyprus | 16,613 | 27,461 | 29,780 | | | |
| Federated Malay States | 21 | | | | | |
| India, British | 9,043 | 11,177 | ([5]) | 7,316 | 6,940 | 5,416 |
| Japan: | | | | | | |
| Japan Proper | [10] 77,973 | [10] 87,600 | ([5]) | 77,973 | 87,600 | ([5]) |
| Chosen | [10] 3,637 | [10] 5,122 | ([5]) | 3,637 | 5,122 | ([5]) |
| Taiwan | [6] 4,000 | ([5]) | ([5]) | | | |
| Turkey | ([5]) | [10] 400 | ([5]) | ([5]) | 400 | ([5]) |
| U. S. S. R. | ([9]) | ([9]) | ([9]) | ([9]) | ([9]) | ([9]) |
| | [9] 115,387 | [9] 136,000 | ([5]) | [9] 88,926 | [9] 100,062 | ([9]) |
| Africa: | | | | | | |
| Algeria | | | 22 | | | |
| Belgian Congo | [10] 95,667 | [10] 150,588 | [10] 124,000 | 95,667 | 150,588 | 124,000 |
| Rhodesia: | | | | | | |
| Northern | 173,468 | 249,835 | ([5]) | 144,617 | 211,513 | 216,450 |
| Southern | 10 | | | | | |
| Union of South Africa | 9,068 | 11,389 | 11,315 | 8,559 | 13,302 | 10,570 |
| | 278,213 | 411,812 | ([5]) | 248,843 | 375,403 | 351,020 |
| Oceania: Australia | 18,859 | 19,434 | 19,305 | 13,527 | 17,679 | ([5]) |
| | 1,726,043 | 2,329,598 | ([5]) | 1,719,475 | 2,343,156 | [13] 2,021,000 |

[1] Copper content of blister produced.
[2] Smelter output from domestic and foreign ores, exclusive of scrap. The production from domestic ores only, exclusive of scrap, was as follows: 1936, 554,659 tons; 1937, 757,188 tons; 1938, 510,133 tons.
[3] Copper content of exports.
[4] Figures represent blister copper only. In addition to blister copper, Belgium reports a large output of refined copper which is not included above as it is believed produced principally from crude copper from the Belgian Congo and would therefore duplicate output reported under the latter country.
[5] Data not yet available. [6] Approximate production. [7] Exclusive of material from scrap.
[8] Smelter output from ores. [9] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.
[10] Smelter product. [11] Exports of ingots and slabs. [12] Less than 1 ton.
[13] Approximate production, based on the output of the countries shown, which in 1937 contributed about 90 percent of the total world output.

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*World consumption.*—World consumption of copper in 1938 declined 10 percent from the high record established in 1937; it exceeded that in any other year except 1937, however, according to figures of the American Bureau of Metal Statistics. The lower total may be ascribed to the 41-percent drop in United States consumption, because the use of copper abroad reached a new high level in 1938. By an examination of world consumption figures it is almost possible to ascertain the countries where disturbed political conditions existed or where war was either under way or anticipated. These data show that apparent consumption rose 42 percent in Austria, 48 percent in Germany, 51 percent in Poland, and 10 percent in Japan over totals for 1937. The consumption figures for these countries are more impressive if compared with 1934, showing gains of 178, 53, 142, and 78 percent, respectively. In comparison with 1934 consumption in U. S. S. R. increased 197 percent and in Czechoslovakia 79 percent, although they gained only 5 percent each in 1938. It is interesting to note that consumption rates in France and the United Kingdom declined 9 and 15 percent, respectively, from 1937 but increased 20 and 17 percent over 1934. Consumption in the United Kingdom, however, was at record-breaking levels in 1937. All foregoing figures are undoubtedly exaggerated for any one year. Surely Germany and Japan cannot have consumed all of the metal made available by production and importation in recent years. Possibly the statistics can be taken to indicate that the United Kingdom acquired a more nearly adequate stock pile of metal in advance of Germany and Japan and that much of the copper credited as consumption in those two countries in 1937 and 1938 went into inventories.

## REVIEW BY COUNTRIES

*Belgian Congo.*—Production of copper in Belgian Congo amounted to about 124,000 metric tons in 1938 compared with 150,588 tons in 1937.

According to an item in the South African Mining and Engineering Journal of December 31, 1938, Prof. Maurice Robert, director of the Geological Service of the Katanga Special Committee, in a report to the Belgian Colonial Institute (Brussels) anticipated that important mining discoveries could still be made and that these discoveries will be made mostly underground. They certainly will be more difficult to work and may have an inferior yield, but their probable existence should extend the life of Katanga as a mining country far longer than is expected at present. Late in 1938 employees at Union Minière du Haut Katanga were estimated to total nearly 1,000 Europeans and about 13,000 natives.

Press reports indicate that copper discoveries in depth by Union Minière in the west are so considerable that they are likely to occupy the main part of company activities in the future and to necessitate transfer of its major operations from Kipushi-Elisabethville-Jadotville to the Kolwezi, where a concentration plant will be erected.

*Canada.*—Production of copper in Canada continued to establish new records in 1938, with a mine total of 293,010 short tons compared with 265,014 in 1937. Smelter production also reached a new high rate, totaling 245,519 tons compared with 231,513 in 1937. Of the

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total mine production 55 percent came from Ontario where the output is entirely from the nickel-copper ores of the Sudbury district. The International Nickel Co. of Canada, Ltd., is the principal producer in this district, whose production of copper is determined by the output of nickel. Operations at the refinery were uniform throughout the year and substantially at present capacity. The Copper Cliff smelter produced 182,904 tons of bessemer matte and 158,912 tons of converter copper. The Ontario Refining Co. Ltd., subsidiary of International Nickel, received 158,793 tons of converter copper in the molten state from the Copper Cliff smelter and produced 145,141 tons of refined copper. Quebec supplied 19 percent of the total, with production principally from Noranda Mines, Ltd. Noranda blister is shipped to the Canadian Copper Refiners, Ltd., at Montreal East. The outstanding achievement of the year was reported to be the discovery at considerable depth of a new ore body in the Amulet section of Waite-Amulet Mines, Ltd., controlled by Noranda, and plans are being made for its development. Noranda smelts the product of Waite-Amulet and Normetal, but Aldermac exports its concentrates. The Consolidated Copper & Sulphur Co., Ltd., operated continuously and exported copper and pyrites concentrates.

The Flin Flon and Sherritt Gordon mines produced the output accredited to Manitoba and Saskatchewan. These mines ship their ores to the Hudson Bay Mining & Smelting Co., Ltd., for smelting. Output in Manitoba increased from 22,460 tons in 1937 to 32,791 in 1938 while that in Saskatchewan dropped from 11,218 to 9,078 tons.

British Columbia production increased from 22,899 short tons in 1937 to 32,571 in 1938 because the mine of Granby Consolidated, reopened in May 1937, produced steadily throughout 1938. The Britannia mine on Howe Sound produced at about the same rate as in 1937. Granby's entire production is being shipped to Japan, and Japanese interests are reported also to have reopened the old Tidewater copper mine on the west coast of Vancouver Island. Copper mining at Britannia Beach was described by Huttl.[7]

The following table shows the production of copper, by Provinces.

*Copper produced (mine output) in Canada, 1937–38, by Provinces, in pounds*

| Province | 1937 | 1938 | Province | 1937 | 1938 |
|---|---|---|---|---|---|
| British Columbia | 45,797,988 | 65,141,290 | Quebec | 94,653,132 | 112,645,797 |
| Manitoba | 44,920,835 | 65,582,772 | Saskatchewan | 22,436,843 | 18,156,157 |
| Nova Scotia | 180,609 | | | 530,028,615 | 586,020,402 |
| Ontario | 322,039,208 | 324,494,386 | | | |

Canada exports most of its copper and in 1938 shipped 54,903 tons of copper in ore, matte, regulus, etc.; 15,264 tons of blister; 181,764 tons of ingots, bars, etc.; 26,756 tons of rods, strips, etc.; and 1,719 tons of old and scrap copper to foreign countries. Of the ore exported 29,257 tons went to the United States and 15,168 tons to Japan. The United Kingdom was the destination of 108,263 tons of the refined ingots and bars exported.

[7] Huttl, John B., Producing Copper at Britannia Beach, B. C.: Eng. and Min. Jour., July 1938, vol. 139, No. 7, pp. 29–35.

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*Chile.*—In 1938 production of copper in Chile amounted to 337,508 metric tons, a decline of 15 percent from the record output of 1937 yet with the exception of that year the highest on record. Mine production totaled 371,370 tons compared with 413,010 in 1937. Copper is a very important source of revenue to the Government of Chile, and plans were being formulated early in 1939 for obtaining additional funds from this industry. A proposal approved by the Chamber of Deputies included a progressive tax on exports—exempting copper below 6 cents (American currency) a pound—of 10 percent on the difference between 6 and 10 cents, 20 percent on the difference between 6 cents and prices above 10 cents and as much as 15 cents, and 30 percent on the difference between 6 cents and amounts above 15 cents a pound. The Chilean Senate, on the contrary, approved a 10-percent tax on copper producers' profits as a substitute. No final decision had been reached by May 1939.

The Instituto de Fomento Minero è Industrial de Antofagasta announced on May 8, 1938, that it had been authorized by the Caja de Credito Minero to purchase low-grade copper ores at 230 Chilean pesos instead of 139, Caja's previous price. It is said the Caja will not realize any profit by paying this higher price but hopes to stimulate the small mining industry of Antofagasta and other Provinces of Northern Chile thereby. It will make available to small miners, at cost, explosives and other materials necessary to the mining of low-grade copper ores.

The Chile Copper Co. produced 148,100 metric tons of copper in 1938 compared with 181,800 in 1937, and Andes Copper 55,200 tons compared with 54,900. These two companies are subsidiaries of Anaconda Copper Mining Co. Braden Copper Co. (subsidiary of Kennecott Copper Corporation) produced 119,800 tons of copper, second only to the record output of 144,300 tons in 1937. During 1938, 7,075,042 short (6,418,337 metric) tons, assaying 2.22 percent copper, were treated. Improvements in metallurgy at the mill resulted in the production of concentrates that averaged 33.08 percent copper compared with about 26 percent before the concentrate grinding and re-treatment plant was placed in operation in 1937. A strike lasting 11 days occurred in July and was amicably settled. The history, geology, mining methods, and safety program of the Braden mine were discussed in an article published in 1938.[8]

Most of the copper produced in Chile is sold for consumption in other countries. Exports of electrolytic copper totaled 184,200 metric tons in 1938 compared with 186,060 in 1937. Of the 1938 total 75,621 tons were shipped to Great Britain, 48,449 to Belgium, 16,919 to Sweden, 16,535 to France, and 12,808 to Italy. Blister exports totaled 165,120 tons in 1938 compared with 197,189 tons in 1937. The United States was the principal destination of the exports of blister in 1938, 56,532 tons going to that country while 50,651 went to Great Britain, 17,786 to Switzerland, 16,105 to Italy, and 10,692 to France. Exports of ore and concentrates fell from 22,707 tons in 1937 to 6,088 in 1938.

*Cyprus.*—Production of copper in Cyprus has increased in recent years. Exports of concentrates totaled 146,550 long tons, estimated

[8] Boletin Minero de la Sociedad Nacional de Mineria, La Braden Copper Co.: Vol. 54, April 1938, pp. 309–315.

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to contain 20 percent copper in 1938 compared with 111,506 tons in 1937 and 58,714 in 1936. Germany received 141,481 metric (139,000 long) tons from Cyprus in 1938 compared with 79,710 (78,500) in 1937.

*Czechoslovakia.*—Demand for copper in Czechoslovakia continued at record-breaking levels and established a new-high record in 1938. This condition was brought about by the disturbed relations with Germany and other neighboring countries, which resulted in Czechoslovakia's annexation by Germany in March 1939. Imports of refined copper and of copper cakes totaled 26,322 metric tons in the first 8 months of 1938 compared with 32,854 tons for the year 1937. Exports were 1,404 and 2,388 tons, respectively. It is reported that the Krompach Copper Works in Slovakia produced 1,000 metric tons of raw copper in 1938 and hoped to treble this production in 1939. An electrolytic refinery is being installed.

*Finland.*—A detailed account of the mining, milling, and smelting methods employed by the Outokumpu Copper Co. and other information on copper production in Finland are given in an article by the general manager published in Mining and Metallurgy for February 1938 and summarized in the Bulletin of the Imperial Institute (London) for April–June 1938. The company is reported to have decided to construct a copper refinery in Imatra and a copper rolling mill near Pori in Bjorneborg where power supplies soon will be available.

*Germany.*—Figures covering mine output of copper in Germany are not available. Those for smelter production in 1938 differed little from those for 1937, showing a small increase. Germany's efforts to become more nearly self-sufficient with regard to its needs for copper, by increasing domestic mining and by curtailing the use of copper wherever substitution could be practiced, failed to make noticeable progress in 1938, when imports of different classes of copper-bearing materials again gained substantially. Imports of copper ores, including cupreous pyrites, totaled 653,931 metric tons compared with 555,578 in 1937 and 482,471 in 1936. It is noteworthy that Cyprus supplied 141,481 tons of the total compared with 79,710 in 1937. Copper imported in ingots, bars, etc., totaled 272,400 tons, of which 76,500 tons were credited to Rhodesia, 62,330 to the United States, 40,007 to Chile, and 39,931 to Belgian Congo. Imports of this class amounted to 169,920 tons in 1937 and 127,549 in 1936. Copper-scrap imports totaled 27,308 tons in 1938 and 32,703 in 1937. Germany exported 5,625 tons of ore, 355 tons of bars, etc., 17,689 tons of rods, sheets, etc., and 4,523 tons of wire in 1938. So much copper has entered Germany in the past several years that it seems almost certain that a stock pile of significant proportions has been accumulated. According to an editorial in the American Metal Market of March 23, 1939, it probably aggregates 200,000 or more tons. Germany's apparent consumption of copper totaled 339,000 metric tons in 1938, 228,300 in 1937, and 185,300 in 1936. These data are calculated in the conventional way on the assumption that metal made available was consumed. Any accumulation of stocks would reduce these figures on consumption.

*Japan.*—Publication of official statistics for Japan was prohibited subsequent to July 31, 1937. Available data, however, indicate that the consumption of copper in this country in 1938 surpassed the high

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record for 1937. Exports of refined copper from the United States increased from 73,000 short (66,000 metric) tons in 1937 to 109,000 short (99,000 metric) tons in 1938. Exports of copper in ore, matte, etc., from Canada to Japan rose from 2,842 short (2,578 metric) tons in 1937 to 15,168 short (13,760 metric) in 1938. According to Brandeis Goldschmidt & Co., Ltd., Japan probably consumed 240,000 long (244,000 metric) tons in 1938 compared with their estimates of 190,000 long (193,000 metric) tons for 1937 and 125,000 long (127,000 metric) tons for 1936. Their estimate for 1938 was made on the assumption of an increase in mine production to 90,000 long (91,000 metric) tons, on a 30,000-ton increase in exports from the United States, and on anticipated increases in receipts of ores and other cupreous materials from Canada, South America, and the Far East. The quantity of stocks accumulated by the Government from the additional tonnages made available during the year cannot be surmised, but it is unreasonable to assume that Japan has used all of the copper acquired in 1937 and 1938. In the middle of 1938 industry was reported to be poorly supplied.

*Northern Rhodesia.*—Smelter output of copper in Northern Rhodesia established a new high record in 1938 with a total of 216,450 metric (213,000 long) tons compared with 211,513 (208,000) in 1937, the previous record year. Although production was a record-breaking rate in 1938 because of agreed restrictions thereon it remained considerably below actual capacity.

Roan Antelope Copper Mines, Ltd., hoisted 3,126,100 short (2,791,161 long) tons of ore during the fiscal year ended June 30, 1938, from which 75,253 long tons of blister copper were produced. In the year immediately preceding 2,880,300 short (2,571,700 long) tons of ore and 69,560 long tons of blister were produced. The average cost was £22.151 per long ton of blister in 1938 compared with £21.880 in 1937. Ore reserves were estimated to be 87,498,099 short tons of ore containing 3.43 percent copper compared with 91,769,128 tons at the end of June 1937. Substantial additions to reserves are expected to result with the opening of ground in the Roan Antelope Extension not included in the original ore-reserve calculation. The company estimated that about £750,000 further expenditure would be required in the fiscal year ending June 1939 to complete the Western extension program and various plant enlargements that will raise the monthly output capacity to 10,000 short tons of copper.

The Rhokana Corporation, Ltd., produced 44,247 long (49,557 short) tons of blister copper and 32,028 (35,871) tons of electrolytic copper, a total of 76,275 (85,428) tons, in the fiscal year ended June 30, 1938, which differed little from the total of 75,254 (84,284) tons for the year immediately preceding. The average cost of blister production was £22 7s. 5d. and of electrolytic copper £24 4s. 3d. As a result of new arrangements the production quota for Rhokana was increased 952 short tons of copper a month, subject to the same percentage increases and decreases as the previous basic quota of 6,338 short tons. In the Nkana section 1,964,900 short tons and in the Mindola section 836,600 short tons were hoisted. A total of 2,796,500 short tons were concentrated during the year compared with 2,651,200 short tons in the fiscal year ended June 30, 1937. The company sold 1,662,771 pounds of cobalt (in alloy and refined

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products) during the year. It has erected a plant for differential flotation of copper and cobalt ores (designed to produce a rich cobalt concentrate) and added a third electric furnace to its cobalt plant. The Nkana copper refinery was described by Wheeler and Eagle.[9] The establishment is a modern furnace and electrolytic plant designed for refining blister copper high in bismuth. This article is briefed in the January (1939) issue of Engineering and Mining Journal. Ore reserves at the end of June 1938 were reported as follows: Nkana North Ore Body, 24,398,056 short tons containing 3.51 percent copper; Mindola Ore Body, 78,378,616 tons containing 3.54 percent; and Nkana South Ore Body, 15,181,000 tons containing 2.79 percent—a total of 117,957,672 tons averaging 3.44 percent copper. Rhokana owns a 32.303-percent interest in Mufulira Copper Mines, Ltd.

Production of copper by the Mufulira Copper Mines, Ltd., was greatly increased in the fiscal year ended June 30, 1938. Ore extracted totaled 1,598,886 short tons containing 4.53 percent copper, ore milled amounted to 1,585,000 short tons, and blister copper was 52,436 long (58,728 short) tons. In the fiscal year ended June 1937 the output of blister copper was 37,230 long (41,698 short) tons. The company's basic quota is 4,811 long (5,388 short) tons of copper a month. During major reverberatory-furnace and waste-heat-boiler repairs in May 5,475 short tons of concentrates were shipped to the Roan Antelope smelter, and 2,573 long (2,882 short) tons of blister copper were produced for Mufulira. Additions to the smelter, to insure uninterrupted operation, were begun and include among other things a second reverberatory furnace, a second 60,000-pound waste-heat boiler, extensions to the converter aisle in both directions, a third 13- by 30-foot converter, and a 13- by 30-foot holding furnace with a second casting machine. Ore reserves comprised 110,499,000 short tons of 4.38-percent copper at Mufulira, 25,000,000 tons of 3.46-percent copper at Chambishi, and 21,000,000 tons of 3.47-percent copper at Baluba, a total of 156,499,000 tons averaging 4.11 percent copper.

*Peru.*—In 1938 the Cerro de Pasco Copper Corporation produced 78,458,979 pounds (35,588 metric tons) of copper, 12,396,991 ounces of silver, 74,063 ounces of gold, 57,329,999 pounds of lead, and 21,379 short tons of zinc concentrates. Production of this company in 1937 amounted to 75,094,065 pounds (34,062 metric tons) of copper, 9,881,827 ounces of silver, 51,455 ounces of gold, 42,005,290 pounds of lead, and 22,946 short tons of zinc concentrates. The corporation is reported to be developing a copper prospect at Ayuricocha, Peru, where 400,000 tons of ore averaging 9 percent copper have been developed.

*Turkey.*—An article in the Engineering and Mining Journal[10] describes conditions regarding copper in Turkey as follows:

> To place the copper mines, which have long remained inactive, again in operation constitutes one of the basic objectives of the Government economic program. The systematic work undertaken should soon show results. In fact, the Ergani mine has already begun producing Standard copper in 1939. The annual production of the company will be 12,000 tons.
>
> Eti Bank has also taken the necessary steps to work the Mourgoul mine, in the Province of Artvin. Plans have been prepared and construction of the plant,

[9] Wheeler, A. E., and Eagle, H. Y., Nkana Copper Refinery of Rhokana Corporation, Ltd.: Trans. Electrochem. Soc., vol. 74, 1938, Preprint 19, 24 pp.

[10] Engineering and Mining Journal, Fifteen Years of Mining in the Turkish Republic: Vol. 140, No. 5, May 1939, p. 34.

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which will be larger than that of the Ergani mine, has begun. The mine's annual capacity will be approximately 12,000 to 15,000 tons.

The Kuvarshan copper mine, in the Province of Artvin, has been in operation for 2 years. After the foreign company, which had been working it, suspended its activities due to the crisis, the Government decided to put it in operation. The Eti Bank, which took possession of it, immediately completed the plant, with the result that the Kuvarshan is now in the exports list. Its annual capacity is about 2,000 tons. In 6 months of 1938 it exported 799 tons, against 200 in the corresponding period of 1937. At this pace, the exportation of copper from the Kuvarshan mines is expected to increase rapidly.

*U. S. S. R.*—Smelter production of copper in the U. S. S. R. increased from 94,250 metric tons in 1937 to 114,552 in 1938 but still lagged far behind Government plans. These called for an output of 135,000 to 145,000 tons in 1937 and for a much larger tonnage in 1938, looking forward to self-sufficiency and an eventual large exportable surplus of copper. Imports of metal during the first 9 months of 1938, however, totaled 49,500 metric tons, the same monthly rate as in1937 and substantially above the monthly rates in earlier recent years. The copper industry in the U. S. S. R. is described in the Bulletin of the Imperial Institute [11] which states that copper reserves of the U. S. S. R. total over 17,000,000 tons of metal. It says furthermore that the most extensive deposits are in Kazakstan, the two main groups being the Kounrad ores near Karsakpai and the Balkhash ores near the northern shore of Lake Balkhash. The Urals also contain considerable deposits of copper ore, and there are other deposits in Uzbekistan, Bashkiria, Middle Volga, West Siberia, Transcaucasia, Leningrad Province, and the Kola Peninsula. The large increase in demand for copper in the U. S. S. R. is due to rearmament, electrification, and rapid industrial development, which have advanced at a greater rate than production, resulting in the large importation already noted. In recent years operations of the copper industry have been changing from small- to large-scale status. The article says:

> Construction of the new works seems to be proceeding very slowly, and some of the "giants" projected some years ago still exist only on paper. A big step toward increased production has been taken by the linking up of two of the main producing areas, the Karsakpai and Balkhash deposits, by rail with Karaganda.
>
> The more important new works, under construction or projected, are:
>
> (1) The Balkhash plant. Construction of this plant was begun in 1930, and although 300 million rubles have been spent on construction and equipment no copper has yet been produced. The first section of the plant is designed to produce 35,000 tons of black copper per annum, and the total eventual output is to be 100,000 tons per annum. It was planned to produce about 12,000 tons in 1937, but as recently as December 10 it was announced that the first section of the concentration plant was only then about to be put into operation.
>
> (2) The Jezkazgan plant at Karsakpai in Kazakstan. This plant, which will work on low-grade ores (metallic content about 1.6 percent), is designed to produce eventually 200,000 tons of black copper per annum. It will be three or four years, however, before production is even begun.
>
> (3) Sreduralmedstroi, the Mid-Ural copper plant. The first section of the concentration plant, treating 2,400 tons of ore a day, was completed early in 1937. The eventual capacity of the concentration plant is 14,000 tons of ore a day, and of the plant as a whole 50,000 tons of copper a year.
>
> (4) Bliava in the Middle Volga region. This plant was expected to start operations in 1937 and to produce up to 5,000 tons of copper in that year. So far as is known it is not yet completed. Its eventual output capacity is stated to be 35,000 tons. It is also proposed at this plant to produce sulphur by the Norwegian patented "Orkla" process.

[11] Imperial Institute (London), The Copper Industry of the U. S. S. R.: Bull., vol. 36, No. 1, January-March 1938, pp. 52-60.

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(5) A nickel-copper plant under construction at Monchegorsk in the Kola Peninsula.

(6) A projected plant to produce 100,000 tons of copper a year on the Central Asian ore deposits near Tashkent.

It will thus be seen that, adding present production of copper to the scheduled output of works under construction or proposed to be constructed in the next few years, the Soviet Union is planning for an eventual output, say within the next ten years, of about 500,000 tons of copper per annum.

Electrolytic copper is produced at present at the Ural works of Pishmin and Kishtin, the former having a potential output capacity of 100,000 tons per annum.

Methods of reducing concentrating and smelting losses are being studied, as it admitted, apparently, that plant efficiency is not satisfactory. Russian Economic Notes [12] state that, of the amount scheduled for capital investment, funds assigned for nonferrous metals recovery will be used chiefly to complete three copper refineries (the Pribalkhash, Central Ural, and Bliava), two nickel combines, and two aluminum plants. The first section of the Balkhash plant, designed for an annual output of 50,000 tons of copper, was put into operation late in 1938. It is reported that this plant is to be enlarged so that it will have a capacity of 100,000 tons by 1942.

*Yugoslavia.*—Mine output of copper in Yugoslavia advanced from 42,300 metric tons in 1937 to 49,500 in 1938. The Mines de Bor, operated under French control, reported the production of 41,992 tons of copper in 1938 compared with 39,410 in 1937. An electrolytic refinery was completed and opened on July 2. At the end of the year production at this plant was reported to be at the rate of 1,000 tons a month. Exports of crude copper began to fall when the new refinery was assured. Imports into the United States of unrefined copper from Yugoslavia declined from 17,300 tons in 1936 to 14,600 in 1937 and 9,600 in 1938.

[12] Bureau of Foreign and Domestic Commerce, Russian Economic Notes: No. 369, July 15, 1938.

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# LEAD[1]

By E. W. Pehrson and H. M. Meyer

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The lead industry in the United States was affected adversely in 1938 by the decline in industrial activity at home and the tendency toward overproduction in the foreign market. Domestic production of refined primary lead decreased 25 percent and domestic shipments 27 percent from 1937. Production from foreign ores and base bullion more than doubled. Imports of crude materials and exports of finished lead products also increased. During the first 5 months of 1938 production exceeded demand, and stocks rose steadily. However, in the second half of the year curtailment of domestic output and improvement in demand caused a sharp reduction in producers' stocks of refined metal to the lowest year-end inventory since 1930. Prices dropped from 4.75 cents per pound at New York on January 1 to a low of 4.00 cents in May and June, rose to 5.10 cents in September to November, and declined to 4.85 cents at the close of the year. The average was 4.74 cents compared with 6.01 cents in 1937. Domestic quotations exceeded London prices by 1.41 cents in 1938 and 0.86 cent in 1937. During the latter half of 1938 weakness in the London market retarded price improvement in the United States.

[1] This report deals primarily with the smelting, refining, and consuming phase of the industry. For full details of mining operations see separate reports issued for the various States.



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*Salient statistics of the lead industry in the United States, 1925–29 (average) and 1934–38, in short tons*

| | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Production of refined primary lead: | | | | | | |
| From domestic ores | 660,525 | 299,841 | 310,505 | 387,698 | 443,142 | 331,964 |
| From foreign ores and base bullion | 123,104 | 11,395 | 14,055 | 11,458 | 24,175 | 51,705 |
| | 783,629 | 311,236 | 324,560 | 399,156 | 467,317 | 383,669 |
| Recovery of secondary lead: | | | | | | |
| As pig lead | 126,600 | 124,500 | 156,800 | 137,500 | 154,500 | 119,400 |
| In alloys | 153,400 | 83,900 | 113,600 | 125,400 | 120,600 | 105,500 |
| | 280,000 | 208,400 | 270,400 | 262,900 | 275,100 | 224,900 |
| Total production of pig lead (primary and secondary) | 910,229 | 436,736 | 481,360 | 536,656 | 621,817 | 503,069 |
| Imports: [1] | | | | | | |
| Lead in base bullion | 95,747 | 2,450 | 2,692 | 312 | 1,800 | 15,296 |
| Lead in ore | 40,096 | 10,611 | 20,025 | 20,713 | 34,103 | 45,370 |
| Exports of refined pig lead | 98,048 | 5,909 | 6,982 | 18,313 | 20,091 | 45,866 |
| Refined primary lead available for consumption | 690,916 | 305,610 | 318,900 | 383,433 | [2] 449,464 | 339,708 |
| Estimated consumption of primary and secondary lead | 900,250 | 488,000 | 538,900 | 633,550 | 678,700 | 546,000 |
| Prices: | | | | | | |
| New York: | | | | | | |
| Average for year, cents per pound | 7.47 | 3.86 | 4.06 | 4.71 | 6.01 | 4.74 |
| Quotation at end of year, do | 6.25 | 3.70 | 4.50 | 6.03 | 4.75 | 4.85 |
| London average, do | 5.87 | 2.46 | 3.12 | 3.91 | 5.15 | 3.33 |
| Mine production of recoverable lead | 664,230 | 287,339 | 331,103 | 372,919 | 464,892 | 369,726 |
| World smelter production of lead | 1,850,000 | 1,465,000 | 1,523,000 | 1,628,000 | 1,858,000 | 1,791,000 |

[1] Data include lead imported for immediate consumption plus material entering the country under bond.
[2] Revised figures.

Figure 1 shows trends in the domestic lead industry since 1900.

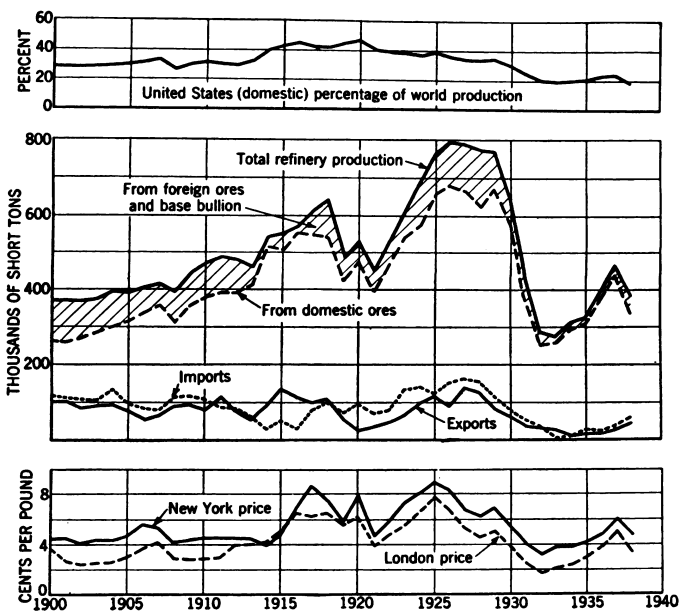


FIGURE 1.—Trends in the lead industry in the United States, 1900–1938. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap and lead exported in manufactures with benefit of draw-back.

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Outside the United States smelter production and consumption again attained new peaks and continued the steady increase that has persisted since 1932. Recovery abroad thus has far surpassed that in the United States. Foreign production in 1938 increased 12 percent compared with 1929, whereas that of the United States decreased 48 percent. Similarly foreign consumption increased 24 percent, whereas domestic demand declined 45 percent. All the more important foreign producers except Mexico, Belgium, and Tunisia increased their smelter outputs in 1938 over 1937. However, Mexico recorded a substantial rise in mine production. Apparent consumption in the United Kingdom, Germany, and Italy was higher in 1938 than in 1937, but that in France, Japan, Belgium, and U. S. S. R. was lower.

An event of unusual significance was the formation of the Lead Producers Association in September 1938. The organization includes most of the important producers outside the United States, and its announced purpose is to balance production with consumption. This action was prompted by the depressed prices on the London market, which reached extremely low levels in June. Effective November 1, 1938, a 10-percent reduction in output was agreed upon, with further curtailment if the market failed to improve.

*Trade agreements with the United Kingdom and Canada.*—As reported in Minerals Yearbook, 1938, the official announcements of the Secretary of State declared that the following lead products would be considered in negotiating a trade agreement with the United Kingdom: Litharge, red lead, suboxide of lead, lead-bearing ores, flue dusts, mattes of all kinds, and miscellaneous commodities. In the Canadian discussions lead ores, etc., as well as lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, and alloys or combinations of lead "not specially provided for" were to be considered. At public hearings begun early in 1938 the lead industry filed briefs protesting any reductions in its protective tariffs. The final treaties were signed on November 17, 1938.

No concessions were made in either treaty on metallic lead or lead-bearing ores, scrap, etc. However, in the agreement with the United Kingdom the import duty on litharge was reduced, effective January 1, 1939, from 2.50 to 2.25 cents per pound, that on red lead from 2.75 to 2.25 cents per pound, and that on lead pigments "not specially provided for" (except suboxide of lead) from 30 percent ad valorem to 20 percent. Other reductions were made on bottle caps, collapsible tubes, and lead manufactures n. s. p. f.

The reciprocal-trade-treaty program thus far has reduced the import duty on several lead products, but no change has been made as yet in the lead industry's basic tariff protection on ores and metal. Zinc producers, however, have not fared so well. In the Canadian Trade Agreement the import duty on zinc ores and slab zinc was reduced 20 percent. An analysis of this cut is presented in the chapter on Zinc.

## DOMESTIC PRODUCTION

Refined pig lead produced in the United States is derived from three main sources—domestic ore, foreign ore and base bullion, and secondary materials. The following table lists the production from each of these sources from 1934 to 1938:

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*Total pig lead produced in the United States, 1934–38, in short tons*

| Year | From domestic ores and base bullion | From foreign ores and base bullion | From secondary materials | Total |
|---|---|---|---|---|
| 1934 | 299,841 | 11,395 | 124,500 | 435,736 |
| 1935 | 310,505 | 14,055 | 156,800 | 481,360 |
| 1936 | 387,698 | 11,458 | 137,500 | 536,656 |
| 1937 | 443,142 | 24,175 | 154,500 | 621,817 |
| 1938 | 331,964 | 51,705 | 119,400 | 503,069 |

## PRIMARY LEAD

*Refinery production.*—Production of refined primary lead in 1938 decreased 18 percent and was only 49 percent of the 1925–29 average. Production from domestic ores decreased 25 percent in 1938, whereas that from foreign ores and base bullion increased 114 percent. Production from foreign materials was the largest since 1931 but represented only 51 percent of the 1929 output.

*Refined primary lead produced in the United States, 1934–38*

| Year | Production by— | | | | | | | Value | |
|---|---|---|---|---|---|---|---|---|---|
| | Classes (short tons) | | | | Sources (short tons) | | | | |
| | Desilverized lead [1] [2] | Soft lead [3] | | Total production [1] | From domestic ores and base bullion | From foreign ores | From foreign base bullion | Average per pound | Total |
| | | Desilverized | Undesilverized | | | | | | |
| 1934 | 186,468 | 22,744 | 102,024 | 311,236 | 299,841 | 10,241 | 1,154 | $0.037 | $23,031,000 |
| 1935 | 192,544 | 35,233 | 96,783 | 324,560 | 310,505 | 13,659 | 396 | .040 | 25,965,000 |
| 1936 | 239,944 | 47,462 | 111,750 | 399,156 | 387,698 | 11,401 | 57 | .046 | 36,722,000 |
| 1937 | 272,051 | 55,317 | 139,949 | 467,317 | 443,142 | 23,393 | 782 | .059 | 55,143,000 |
| 1938 | 243,891 | 31,986 | 107,792 | 383,669 | 331,964 | 32,862 | 18,843 | .046 | 35,298,000 |

[1] The lead content of antimonial lead is excluded.
[2] Desilverized soft lead is excluded.
[3] Includes lead derived from Missouri ores and other nonargentiferous ores.

*Source of primary lead.*—Of the total refined lead produced in 1938, 87 percent was derived from domestic ores and 13 percent from foreign ores and base bullion. Production from foreign ores increased 40 percent in 1938 and was the highest since 1930. Refining of foreign bullion was resumed on a large scale in 1938, chiefly because of the closing of one of the Mexican refineries during the latter part of the year, which diverted bullion to domestic plants. Details of the sources of lead from domestic ores are given in the section on Mine Production.

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*Refined primary lead produced in the United States, 1934–38, by sources, in short tons*

| Source | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Domestic ore | 299,841 | 310,505 | 387,698 | 443,142 | 331,964 |
| Foreign ore: | | | | | |
| Australia | 115 | | 172 | 3,088 | 7,320 |
| Canada | 2,514 | 1,039 | 2,277 | 5,343 | 3,562 |
| Europe | 45 | 1,086 | 1,133 | 388 | 14 |
| Mexico | 1,011 | 5,809 | 1,486 | 3,836 | 9,745 |
| South America | 4,028 | 2,872 | 3,883 | 8,497 | 9,887 |
| Other foreign | 2,528 | 2,853 | 2,450 | 2,241 | 2,334 |
| | 10,241 | 13,659 | 11,401 | 23,393 | 32,862 |
| Foreign base bullion: | | | | | |
| Mexico | 703 | 396 | 57 | 782 | 18,268 |
| South America | 451 | | | | |
| Other foreign | | | | | 575 |
| | 1,154 | 396 | 57 | 782 | 18,843 |
| Total foreign | 11,395 | 14,055 | 11,458 | 24,175 | 51,705 |
| Grand total | 311,236 | 324,560 | 399,156 | 467,317 | 383,669 |

*Antimonial lead.*—Antimonial or hard lead is an important by-product of the refining of base bullion, but the quantity derived from this source is only a small part of the country's yearly production. The major part is obtained from the smelting of antimonial-lead scrap, and some is produced by mixing metallic antimony with refined soft lead.

Several lead-smelting plants operate on scrap materials exclusively. Production data from such plants are summarized in the chapter in this volume on Secondary Metals—Nonferrous. A large quantity of hard lead scrap also is treated at primary smelters and refineries, and the production of antimonial lead at these plants is shown in the table that follows:

*Antimonial lead produced at primary lead refineries, 1934–38*

| Year | Production (short tons) | Antimony content | | Lead content by difference (short tons) | | | |
|---|---|---|---|---|---|---|---|
| | | Short tons | Percent | From domestic ore | From foreign ore | From scrap | Total |
| 1934 | 16,607 | 2,363 | 13.6 | 5,901 | 330 | 8,113 | 14,344 |
| 1935 | 16,384 | 1,729 | 10.6 | 4,685 | 491 | 9,479 | 14,655 |
| 1936 | 23,230 | 2,162 | 9.3 | 7,442 | 696 | 12,930 | 21,068 |
| 1937 | 27,524 | 2,579 | 9.4 | 7,833 | 1,721 | 15,391 | 24,945 |
| 1938 | 24,123 | 2,809 | 11.6 | 6,759 | 3,385 | 11,170 | 21,314 |

## SECONDARY LEAD

Recovery of secondary lead decreased 18 percent in 1938. Return of battery scrap for smelting and refining declined in 1938, and stocks at scrap-consuming plants were considerably higher at the end of the year than at the beginning. As the output of domestic refined primary lead dropped 25 percent, the ratio of secondary to primary lead

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production increased from 62 to 68 percent. Additional details on production of secondary lead in 1938 are given in the chapter in this volume on Secondary Metals—Nonferrous.

*Secondary lead recovered in the United States, 1934–38*

[Compiled by J. P. Dunlop]

| Year | Pig lead (short tons) | | | Lead in alloys (short tons) | Total recovered lead | | |
|---|---|---|---|---|---|---|---|
| | At primary plants | At secondary plants | Total | | Short tons | Value | Ratio to domestic refined primary lead (percent) |
| 1934 | 33,557 | 90,943 | 124,500 | 83,900 | 208,400 | $15,421,600 | 70 |
| 1935 | 44,748 | 112,052 | 156,800 | 113,600 | 270,400 | 21,632,000 | 87 |
| 1936 | 34,556 | 102,944 | 137,500 | 125,400 | 262,900 | 24,186,800 | 68 |
| 1937 | 29,986 | 124,514 | 154,500 | 120,600 | 275,100 | 32,461,800 | 62 |
| 1938 | 24,800 | 94,600 | 119,400 | 105,500 | 224,900 | 20,690,800 | 68 |

## LEAD PIGMENTS

Lead pigments manufactured in 1938 contained 174,853 tons of lead, a decrease of 21 percent from 1937. Of this total, 162,828 tons were derived from refined pig lead; white lead comprised 46 percent, litharge 37 percent, red lead 16 percent, and sublimed lead and orange mineral 1 percent. Sublimed lead and leaded zinc oxide are the principal pigments in which the lead content is derived from ores.

*Lead in pigments,[1] 1934–38, by sources, in short tons*

| Year | Lead in pigments from— | | | | Year | Lead in pigments from— | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Domestic ore [2] | Metal | Scrap | Total | | Domestic ore [2] | Metal | Scrap | Total |
| 1934 | 7,538 | 157,294 | 379 | 165,211 | 1937 | 17,363 | 204,961 | 127 | 222,451 |
| 1935 | 12,109 | 185,151 | 144 | 197,404 | 1938 | 12,025 | 162,828 | ------- | 174,853 |
| 1936 | 15,062 | 204,997 | 37 | 220,096 | | | | | |

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.
[2] No pigments from foreign ore.

## MINE PRODUCTION

Production of lead from domestic mines in 1938 decreased 21 percent from 1937, returning to the 1936 level. All three major producing regions shared the lower rate, with percentage declines as follows: Southeastern Missouri 22 percent, Coeur d'Alene 15, and Utah 27. Output in the Bingham district fell only 9 percent, but that in the Joplin region was 22 percent lower than in 1937. The closing of the Silver King Coalition and Park Utah Consolidated mines early in 1938 was mainly responsible for the fall in output of the Park City region which, in turn, was chiefly responsible for Utah's lower production. The Butte (Mont.) district produced only 204 tons of lead in 1938 compared with 5,780 tons in 1937 and more than 10,000 tons each in 1936 and 1935. Output in the Warm Springs (Idaho), San Juan Mountains (Colo.), and Metaline (Wash.) districts reversed the general downward trend and increased 84, 18, and 52 percent, respectively. Further details of production by mines, districts, and States can be found in the various State reports.

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*Mine production of recoverable lead in the United States, 1925–29 (average) and 1934–38, in short tons*

| State | 1925–29 average | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Western States and Alaska: | | | | | | |
| Alaska | 982 | 747 | 670 | 941 | 823 | 994 |
| Arizona | 9,743 | 3,439 | 7,783 | 10,688 | 12,354 | 10,571 |
| California | 2,070 | 412 | 567 | 482 | 1,186 | 495 |
| Colorado | 30,112 | 4,218 | 5,673 | 7,267 | 9,786 | 9,455 |
| Idaho | 141,610 | 71,324 | 79,020 | 91,339 | 103,711 | 92,177 |
| Montana | 18,871 | 10,005 | 15,589 | 19,059 | 17,957 | 9,327 |
| Nevada | 9,807 | 10,991 | 12,676 | 10,712 | 9,347 | 4,679 |
| New Mexico | 6,730 | 9,365 | 7,289 | 6,626 | 6,512 | 4,949 |
| Oregon | 6 | 21 | 30 | 79 | 109 | 23 |
| South Dakota | 21 | | 4 | | | |
| Texas | 213 | 360 | 522 | 468 | 395 | 342 |
| Utah | 149,509 | 58,077 | 63,510 | 69,886 | 89,458 | 65,657 |
| Washington | 1,323 | 291 | 103 | 840 | 2,830 | 4,284 |
| Wyoming | | 1 | 3 | | | |
| | 370,997 | 169,251 | 193,439 | 218,387 | 254,468 | 202,953 |
| Central States: | | | | | | |
| Arkansas | 38 | 40 | 38 | 24 | 40 | 7 |
| Illinois | 552 | 40 | 436 | 294 | 186 | 175 |
| Kansas | 26,121 | 6,805 | 10,892 | 11,409 | 16,008 | 15,239 |
| Kentucky | 135 | 104 | 132 | 50 | 89 | 101 |
| Missouri | 202,240 | 90,493 | 97,493 | 110,428 | 157,631 | 122,027 |
| Oklahoma | 58,306 | 16,747 | 23,405 | 25,427 | 29,840 | 21,004 |
| Wisconsin | 1,745 | 234 | 286 | 904 | 1,091 | 320 |
| | 289,137 | 114,463 | 132,682 | 148,536 | 204,885 | 158,873 |
| Eastern States: | | | | | | |
| New York | | | | | | |
| Tennessee | 4,096 | 3,625 | 4,982 | 5,996 | 5,539 | 7,896 |
| Virginia | | | | | | |
| North Carolina | | | | | | 4 |
| | 4,096 | 3,625 | 4,982 | 5,996 | 5,539 | 7,900 |
| | 664,230 | 287,339 | 331,103 | 372,919 | 464,892 | 369,726 |

*Mine production of recoverable lead in the principal lead-producing districts of the United States, 1934–38, in short tons*

| District | State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Southeastern Missouri region | Missouri | 89,580 | 96,941 | 108,422 | 153,205 | 118,870 |
| Coeur d'Alene region | Idaho | 70,331 | 78,290 | 86,634 | 96,505 | 82,274 |
| Bingham | Utah | 32,420 | 36,293 | 32,451 | 45,233 | 41,334 |
| Joplin region | Kansas, Missouri, Oklahoma. | 24,465 | 34,849 | 38,842 | 50,274 | 39,406 |
| Tintic | Utah | 5,715 | 5,833 | 7,063 | 10,198 | 9,605 |
| Warm Springs | Idaho | 8 | 32 | 2,757 | 4,004 | 7,370 |
| Park City region | Utah | 12,360 | 13,180 | 17,421 | 22,417 | 7,258 |
| San Juan Mountains | Colorado | 1,651 | 2,428 | 3,279 | 4,998 | 5,885 |
| Rush Valley | Utah | 5,594 | 4,907 | 8,191 | 6,410 | 4,619 |
| Eagle | Montana | 2,560 | 1,121 | 3,113 | 4,812 | 4,301 |
| Willow Creek | New Mexico | 6,143 | 5,162 | 3,746 | 3,852 | 4,277 |
| Oro Blanco | Arizona | 1,676 | 4,717 | 4,426 | 3,864 | 4,150 |
| Metaline | Washington | 237 | (1) | 770 | 2,644 | 4,009 |
| Wallapai | Arizona | 6 | 70 | 841 | 2,489 | 4,004 |
| Pioche | Nevada | 4,644 | 4,955 | 4,706 | 4,759 | 3,214 |
| Ophir | Utah | 1,349 | 2,392 | 3,862 | 3,307 | 2,013 |
| Old Hat | Arizona | 65 | 292 | 463 | 794 | 1,919 |
| Cataract | Montana | 259 | 1,227 | 1,704 | 1,946 | 1,326 |
| Leadville | Colorado | 524 | 1,288 | 1,550 | 2,100 | 1,222 |
| Hog Heaven | Montana | 1 | | | 808 | 1,214 |
| Smelter | do | 676 | 1,239 | 945 | 1,178 | 710 |
| Central | New Mexico | 2,846 | 1,891 | 2,689 | 2,281 | 340 |
| Upper Mississippi Valley | Iowa, northern Illinois, Wisconsin. | 234 | 286 | 904 | 1,091 | 320 |
| Tombstone | Arizona | 1,200 | 1,081 | 417 | 315 | 315 |
| Banner | do | 77 | 857 | 1,541 | 1,205 | 302 |
| Butte | Montana | 5,391 | 10,302 | 10,527 | 5,780 | 204 |
| Flint Creek | do | 400 | 988 | 1,496 | 1,511 | 113 |
| Bisbee (Warren) | Arizona | 64 | 200 | 1,154 | 1,018 | 14 |
| Tybo | Nevada | 4,285 | 5,519 | (1) | 2,439 | |
| Austinville [2] | Virginia | (1) | (1) | (1) | (1) | (1) |
| St. Lawrence County [2] | New York | (1) | (1) | (1) | (1) | (1) |

[1] Bureau of Mines not at liberty to publish figures.

[2] Not listed according to rank.

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## STOCKS

Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by most refiners of secondary material who produce common lead. Foreign lead refined in the United States and entered for domestic consumption is included.

*Lead stocks at end of year at smelters and refineries in the United States, 1934–38, in short tons*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Refined pig lead | 223,593 | 215,595 | 165,159 | 119,837 | 102,489 |
| Antimonial lead | 10,437 | 6,711 | 6,697 | 9,294 | 13,413 |
| | 234,030 | 222,306 | 171,856 | 129,131 | 115,902 |
| Lead in base bullion: | | | | | |
| At smelters and refineries | 6,045 | 15,072 | 9,187 | 10,959 | 18,693 |
| In transit to refineries | 1,528 | 1,860 | 1,070 | 2,219 | 2,339 |
| In process at refineries | 11,567 | 16,233 | 14,100 | 14,413 | 16,690 |
| | 19,140 | 33,165 | 24,357 | 27,591 | 37,722 |
| Lead in ore and matte and in process at smelters | 60,699 | 58,562 | 50,098 | 52,081 | 56,332 |
| | 313,869 | 314,033 | 246,311 | 208,803 | 209,956 |

The upward trend in stocks evident in the last quarter of 1937 continued in the first half of 1938, as production continued to exceed shipments to consumers. During the latter half of the year the trend was reversed following improvement in demand and curtailment of production. Inventories of refined and antimonial lead at refineries reached a peak of 164,600 tons at the end of May, declined to 115,100 tons on December 1, and rose slightly during the last month of the year. The year-end stock of refined and antimonial lead was the lowest since 1930. The decline in the quantity of refined products on hand was offset partly by increases in stocks of base bullion and ore and matte in process.

Published data on the status of foreign lead stocks are not available, but the weak London market during 1938 and the organization of a producer's cartel to balance production and consumption suggests that large stocks of metal are held abroad.

## DOMESTIC CONSUMPTION

*New supply.*—The following table shows the refined primary lead available for consumption from 1934 to 1938, inclusive. The figures do not take into account variations in producers' stocks, and as these have changed considerably during the past 5 years the quantities stated do not indicate the true trend in the actual consumption of new lead. The supply available for consumption in 1938 was 24 percent less than in 1937 and was equivalent to only 49 percent of the 1925–29 average. The total consumption of lead, as indicated by the second table following, fell only 20 percent.

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*Refined primary pig lead available for consumption in the United States, 1934–38, in short tons*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Supply: | | | | | |
| Imports | [1] 283 | [1] 1,322 | [1] 2,590 | 2,238 | 1,905 |
| Production | 311,236 | 324,560 | 399,156 | 467,317 | 383,669 |
| | 311,519 | 325,882 | 401,746 | 469,555 | 385,574 |
| Withdrawn: | | | | | |
| Exports [2] | 5,909 | 6,982 | 18,313 | 20,091 | [3] 45,866 |
| Supply available for consumption | 305,610 | 318,900 | 383,433 | [4] 449,464 | 339,708 |

[1] Includes small quantities of old, reclaimed, and scrap lead.
[2] Includes small quantities of foreign lead reexported.
[3] Includes a small quantity, not separable, of "sheets."
[4] Revised figures.

*Consumption by uses.*—Owing to the return of large quantities of secondary lead in discarded and obsolete articles and from the lead-consuming industries, the total consumption of pig lead greatly exceeds the supply of new lead available. The following table gives the American Bureau of Metal Statistics estimate of the total consumption of lead by industries, 1934–38.

*Lead consumed in the United States,[1] 1934–38, in short tons*

| Purpose | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| White lead | 64,500 | 80,000 | 85,500 | 86,000 | 71,000 |
| Red lead and litharge | 42,000 | 47,500 | 54,000 | 57,000 | 43,000 |
| Storage batteries | 163,000 | 175,000 | 191,000 | 192,000 | 167,000 |
| Cable covering | 35,200 | 38,900 | 61,400 | 90,000 | 60,000 |
| Building | 30,000 | 32,000 | 40,000 | 45,000 | 36,000 |
| Automobiles | 7,300 | 10,000 | 11,100 | 12,000 | 6,000 |
| Railway equipment | 1,100 | 500 | 2,400 | 3,800 | 1,200 |
| Shipbuilding | 200 | 200 | 200 | 300 | 300 |
| Ammunition | 34,800 | 29,200 | 32,500 | 39,500 | 31,200 |
| Terneplate | 2,600 | 4,700 | 6,200 | 6,400 | 4,300 |
| Foil | 16,200 | 15,900 | 28,500 | 21,700 | 22,000 |
| Bearing metal | 12,100 | 13,000 | 16,500 | 15,000 | 9,000 |
| Solder | 16,000 | 20,000 | 22,000 | 22,000 | 15,000 |
| Type metal | 13,000 | 15,000 | 17,000 | 17,000 | 12,000 |
| Calking | 10,000 | 12,000 | 13,500 | 15,000 | 12,000 |
| Castings | 5,000 | 5,000 | 5,750 | 6,000 | 6,000 |
| Other uses | 35,000 | 40,000 | 46,000 | 50,000 | 50,000 |
| | 488,000 | 538,900 | 633,550 | 678,700 | 546,000 |

[1] American Bureau of Metal Statistics. These estimates are for the total consumption of lead irrespective of whether its origin is primary or secondary. Antimonial lead is included.

Lead consumption in the United States in 1938 was 20 percent below 1937 and 44 percent below the record established in 1929. Storage batteries require more lead than any other industry, the quantity so used in 1938 representing 31 percent of the total. This industry fared better than most other important lead-consuming industries, both in relation to 1937 and 1929; the declines were 13 and 20 percent, respectively, from those 2 years. Although it is desirable to have large requirements of lead for the manufacture of storage batteries, lead withdrawn for this use returns quickly to the market in the form of scrap and there competes with primary metal. As one authority

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stated, lead so used is more in the nature of a loan. The quantity of lead consumed in foil was 1 percent higher in 1938 than in 1937 but 45 percent lower than in 1929, while that used for red lead and litharge, exclusive of the quantities of these pigments consumed in storage batteries, was 25 percent below 1937 but 43 percent above 1929. As has been stated in recent chapters of this series, the principal difficulties of the lead industry from the standpoint of consumption are due to the failure of the utility industry to purchase its proportionate share of the total and the low requirements of the building industry. Quantities used by both of these industries rose in 1937, but they declined again in 1938 and represented only 27 and 38 percent, respectively, of the totals for 1929. White lead is a most important outlet for lead, not only because of the large tonnage involved but particularly because metal so consumed is dissipated. Early in 1939 the Lead Industries Association, with this in mind, announced a 3-year promotion campaign designed to increase the use of white-lead paint.

## PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in the United States is sold at prices based on quotations in these markets. The New York quotations are influenced to some extent by the lower prices usually prevailing on the London market, so that the New York price seldom exceeds the St. Louis price by as much as the freight differential, which normally is 0.35 cent a pound.

The New York quotation for common lead averaged 4.74 cents a pound in 1938, a decrease of 21 percent from 1937 but slightly above the 4.71 cents recorded for 1936. The price was 4.75 cents as the year began, following a decline from 6.50 cents in September 1937. It increased slightly in January but resumed its downward trend at the end of the month, reaching 4 cents at the end of May, the lowest quotation of the year. During this period shipments were continuously below production, and refinery stocks advanced from 90,742 tons at the end of September 1937 to 164,636 at the end of May 1938. A virtual balance between output and shipments was attained in June, and stocks declined from then until December. Heavy buying of lead took place in June and July, and the price advanced 0.75 cent in June to 4.75 cents and continued upward to 5.12½ cents in September. During July and August weakness in the London position deterred price improvement in New York. In September important foreign producers met and decided on a 10-percent reduction in output. This action improved sentiment abroad and reacted favorably on the New York market. Sales were at a high level in the last quarter except for about 4 weeks beginning the middle of November. Sales jumped following a reduction in price to 4.75 cents in December. They were 16,287 tons in 1 week, and the price was raised to 4.85 cents, at which level it closed the year.

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*Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1936–38, in cents per pound* [1]

| Month | 1936 | | | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|---|---|---|
| | St. Louis | New York | London | St. Louis | New York | London | St. Louis | New York | London |
| January | 4.35 | 4.50 | 3.41 | 5.85 | 6.03 | 5.97 | 4.72 | 4.89 | 3.60 |
| February | 4.37 | 4.52 | 3.58 | 6.09 | 6.26 | 6.19 | 4.48 | 4.63 | 3.45 |
| March | 4.45 | 4.60 | 3.69 | 7.05 | 7.20 | 7.20 | 4.35 | 4.50 | 3.56 |
| April | 4.45 | 4.60 | 3.55 | 6.03 | 6.18 | 5.71 | 4.35 | 4.50 | 3.46 |
| May | 4.45 | 4.60 | 3.45 | 5.85 | 6.00 | 5.28 | 4.25 | 4.40 | 3.15 |
| June | 4.45 | 4.60 | 3.40 | 5.85 | 6.00 | 5.03 | 4.00 | 4.15 | 3.09 |
| July | 4.45 | 4.60 | 3.55 | 5.85 | 6.00 | 5.30 | 4.73 | 4.88 | 3.28 |
| August | 4.45 | 4.60 | 3.76 | 6.30 | 6.46 | 5.02 | 4.75 | 4.90 | 3.13 |
| September | 4.45 | 4.60 | 4.05 | 6.23 | 6.39 | 4.63 | 4.85 | 5.01 | 3.27 |
| October | 4.49 | 4.65 | 4.03 | 5.56 | 5.71 | 4.03 | 4.95 | 5.10 | 3.44 |
| November | 4.96 | 5.14 | 4.74 | 4.88 | 5.03 | 3.72 | 4.94 | 5.09 | 3.38 |
| December | 5.40 | 5.57 | 5.60 | 4.72 | 4.86 | 3.54 | 4.69 | 4.84 | 3.15 |
| Average | 4.56 | 4.71 | [2] 3.91 | 5.86 | 6.01 | [2] 5.15 | 4.59 | 4.74 | [2] 3.33 |

[1] St. Louis: Metal Statistics, 1939, p. 423. Average daily quotations of soft Missouri lead, f. o. b. St. Louis (open market), as reported daily in the American Metal Market.
New York: American Metal Market, daily issues. Pig lead, New York (outside market), prompt shipment from West.
London: Metal Statistics, 1939, p. 427. Average price of foreign lead. Price per long ton, as published in Metal Statistics, converted to cents per pound at average exchange rate reported by the Federal Reserve Board.
[2] London quotations in pounds sterling per long ton, as follows: 1936, £17.6000; 1937, £23.3250; 1938, £15.2667.

The London quotation ranged from a high monthly average of 3.60 cents a pound (United States exchange basis) in January to a low of 3.09 cents in June. It advanced to 3.44 cents in October but declined to 3.15 cents in December. The differential between the selling prices in the New York and London markets was much higher in 1938 than in 1937. It was lowest in March (0.94 cent) and highest in August (1.77 cents). The difference in price averaged 1.41 cents for the year compared with 0.86 cent in 1937 and 0.80 cent in 1936.

## FOREIGN TRADE [2]

The foreign trade of the United States in lead consists largely of imports of ore and base bullion, which are smelted and refined in bond, and the export of this lead either as pig lead or in manufactured products. This trade reached a peak in 1927 but dwindled to very small proportions in 1933. Since then, however, there has been substantial improvement. Imports of lead in ore, base bullion, and refined and scrap lead totaled 161,389 tons in 1927, 7,654 tons in 1933, and 63,901 tons in 1938; exports of refined lead decreased from 125,267 tons in 1927 to 5,909 in 1934 and advanced to 45,866 tons in 1938. In the same years exports of lead in manufactures with benefit of draw-back were 12,004, 7,472 and 9,061 tons, respectively.

*Imports.*—Total imports of lead in ore and matte, including imports for immediate consumption and entries for warehouse, increased 33 percent in 1938 owing chiefly to larger shipments from Mexico, Australia, and Chile. Imports of base bullion from Mexico likewise

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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increased substantially, but the quantity of refined lead and scrap received from abroad declined. Most of the refined lead imported in 1938 came from Peru. Total imports of lead in all the above forms increased 57 percent over 1937.

*Total lead imported into the United States, 1934–38, by classes, in short tons* [1]

| Year | Lead in ore and matte | Lead in base bullion | Pigs, bars, sheets, and old | Total lead content |
|---|---|---|---|---|
| 1934 | 10,611 | 2,450 | 283 | 13,344 |
| 1935 | 20,025 | 2,692 | 1,322 | 24,039 |
| 1936 | 20,713 | 312 | 2,590 | 23,615 |
| 1937 | 34,103 | 1,800 | 4,903 | 40,806 |
| 1938 | 45,370 | 15,296 | 3,235 | 63,901 |

[1] Data include lead imported for immediate consumption plus material entering the country under bond.

*Total lead imported into the United States, in ore, base bullion, and refined, 1934–38, by countries, in short tons* [1]

| Year | Canada | Mexico | Newfoundland | South America | Europe | Other countries | Total |
|---|---|---|---|---|---|---|---|
| 1934 | 1,160 | 3,270 | 3,357 | 5,455 | 67 | 35 | 13,344 |
| 1935 | 236 | 9,786 | 6,837 | 6,643 | 512 | 25 | 24,039 |
| 1936 | 1,692 | 10,501 | 3,955 | 6,861 | 341 | 265 | 23,615 |
| 1937 | 5,749 | 17,068 | ---------- | 13,229 | 535 | 4,225 | 40,806 |
| 1938 | 3,174 | 38,467 | ---------- | 13,426 | 680 | 8,154 | 63,901 |

[1] Data include lead imported for immediate consumption plus material entering the country under bond.

*Total lead imported into the United States in ore, matte, and base bullion, 1934–38, by countries, in short tons* [1]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| In ore and matte: | | | | | |
| Canada | 902 | 58 | 1,419 | 5,211 | 3,173 |
| Chile | 1,443 | 1,102 | 574 | 474 | 2,107 |
| Mexico | 1,283 | 7,986 | 10,462 | 15,970 | 24,023 |
| Newfoundland | 3,357 | 6,818 | 3,955 | ---------- | ---------- |
| Peru | 3,545 | 3,716 | 4,007 | 10,132 | 9,317 |
| Other countries | 81 | 345 | 296 | 2,316 | 6,750 |
| | 10,611 | 20,025 | 20,713 | 34,103 | 45,370 |
| In base bullion: | | | | | |
| Mexico | 1,987 | 1,746 | 39 | 1,067 | 14,444 |
| Peru | 463 | 784 | 52 | 239 | 198 |
| Other countries | ---------- | 162 | 221 | 494 | 654 |
| | 2,450 | 2,692 | 312 | 1,800 | 15,296 |

[1] Data include lead imported for immediate consumption plus material entering the country under bond.

*Lead remaining in warehouses in the United States, Dec. 31, 1934–38, in short tons*

[Stated in the form in which the material was entered for warehouse]

| Year | Lead in ore and matte | Lead in base bullion [1] | Year | Lead in ore and matte | Lead in base bullion [1] |
|---|---|---|---|---|---|
| 1934 | 15,709 | 606 | 1937 | 57,509 | 2,622 |
| 1935 | 22,598 | 2,173 | 1938 | 76,287 | 11,524 |
| 1936 | 33,401 | 1,930 | | | |

[1] Pigs, bars, sheets, and old lead included with basebullion.

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*Lead[1] imported for consumption in the United States, 1934–38, by classes*

| Year | Lead in ores, flue dust, and mattes, n. s. p. f. | | Lead in base bullion | | Pigs and bars | | Sheets, pipe, and shot | | Not otherwise specified | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | | |
| 1934 | 10,760 | $558,558 | 2,220 | $117,729 | | | 286 | $35,130 | $12,940 | $735,035 |
| 1935 | 8,273 | 258,954 | 1,154 | 66,559 | 1,368 | $83,841 | 404 | 51,979 | 12,484 | 489,775 |
| 1936 | 5,836 | 225,568 | 763 | 45,340 | 1,979 | 97,614 | 304 | 38,546 | 12,729 | 443,331 |
| 1937 | 5,613 | 507,945 | 188 | 12,788 | 2,355 | 174,077 | 376 | 54,649 | 13,527 | 793,796 |
| 1938 | 6,722 | 543,164 | 304 | 31,147 | 2,001 | 84,109 | 166 | 30,906 | 23,381 | 733,081 |

[1] In addition 285 tons valued at $10,678 of "reclaimed, scrap, etc." were imported in 1934; 223 tons, $15,958 in 1935; 342 tons, $23,534 in 1936; 349 tons, $30,810 in 1937; and 189 tons, $20,374 in 1938; value included in total value.

*Miscellaneous products containing lead imported for consumption in the United States, 1934–38*

| Year | Babbitt metal, solder, white metal, and other combinations containing lead | | | Type metal and antimonial lead | | |
|---|---|---|---|---|---|---|
| | Gross weight (short tons) | Lead content (short tons) | Value | Gross weight (short tons) | Lead content (short tons) | Value |
| 1934 | 709 | 102 | $71,505 | 112 | 94 | $6,784 |
| 1935 | 128 | 24 | 44,269 | 534 | 445 | 36,453 |
| 1936 | 334 | 67 | 112,205 | 456 | 400 | 34,694 |
| 1937 | 618 | 178 | 213,734 | 132 | 115 | 13,572 |
| 1938 | 390 | 77 | 126,660 | 433 | 374 | 38,708 |

*Exports.*—Exports of pigs, bars, and old lead more than doubled in 1938 as a result of the increase in custom smelting and refining of foreign ores and base bullion. A large part of the increase was credited to Japan, which purchased over four times as much in 1938 as in 1937. During the past 3 years substantial tonnages have been shipped to Mexico. This lead was base bullion derived from Mexican ores and returned to Mexico for refining.

*Lead exported from the United States 1934–38* [1]

| Year | Pigs, bars, and old | | Foreign lead exported in manufactures with benefit of draw-back (short tons) | Year | Pigs, bars, and old | | Foreign lead exported in manufactures with benefit of draw-back (short tons) |
|---|---|---|---|---|---|---|---|
| | Short tons | Value | | | Short tons | Value | |
| 1934 | 5,909 | $305,994 | 7,472 | 1937 | 20,091 | $1,838,262 | 8,679 |
| 1935 | 6,982 | 472,017 | 8,995 | 1938 | [2] 45,866 | [2] 3,354,616 | 9,061 |
| 1936 | 18,313 | 1,390,454 | 8,312 | | | | |

[1] Includes small quantities of foreign lead reexported.
[2] Contains sheets and pipes; figures not separable.

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*Pig lead* [1] *exported from the United States, 1934–38, by destinations, in short tons*

| Destination | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Countries: | | | | | |
| Argentina | (2) | | 3 | 8 | 10 |
| Brazil | 475 | 338 | 795 | 652 | 110 |
| Canada | 21 | 45 | 45 | 7 | 101 |
| Finland | | | | | 560 |
| Germany | | 11 | 2 | 568 | 1,092 |
| Japan | 4,454 | 5,324 | 8,629 | 7,320 | 30,203 |
| Kwantung | | | | | 314 |
| Mexico | 21 | 38 | 8,049 | 8,122 | 11,403 |
| Netherlands | 4 | 188 | | | |
| Philippine Islands | 169 | 217 | 223 | 569 | 1,037 |
| United Kingdom | 36 | 8 | 123 | 2,226 | 78 |
| Uruguay | 221 | 112 | | | |
| Other countries | 508 | 701 | 444 | 619 | 958 |
| | 5,909 | 6,982 | 18,313 | 20,091 | 45,866 |
| Continents: | | | | | |
| North America | 107 | 157 | 8,282 | 8,337 | 12,002 |
| South America | 1,076 | 668 | 1,021 | 784 | 303 |
| Europe | 40 | 212 | 133 | 2,949 | 1,950 |
| Asia | 4,684 | 5,945 | 8,865 | 7,989 | 31,606 |
| Africa and Oceania | 2 | (2) | 12 | 32 | 5 |

[1] Includes small quantities of foreign lead reexported.
[2] Less than 1 ton.

## TECHNOLOGY

*Mining.*—Ore pillars in the Southeast Missouri district are being mined and replaced with concrete. Preliminary attempts on some of the smaller pillars have been successful, and plans are under way for mining larger blocks of ore left for roof support. One of the major problems involved is the determination of the load carried by the pillar in order that the volume of concrete used may be kept at a minimum compatible with safety. In this connection the Bureau of Mines method [3] of ascertaining rock pressures by measuring the velocity of sound is being investigated as a practical means of measuring the load on the pillars.

Probert [4] and Parks [5] have summarized progress in mining technique during 1938, and articles by Schmitt [6] and Behre [7] review recent developments in mining geology. Drilling practice in the Tri-State region has been described by Nicolson.[8]

*Milling.*—According to Engelmann, Minerec A is now being used in about 80 percent of the western lead-zinc mills, where it has partly or completely replaced xanthate in the lead circuits. The new sloping-side Fagergren flotation machine has found favor with lead-zinc operators.[9] Fahrenwald [10] reports substantial improvement in ore-dressing practice and equipment during 1938. A method of treating lead-zinc-fluorspar ores by flotation has been developed by the Bureau

[3] Obert, Leonard, Measurement of Pressure on Rock Pillars in Underground Mines: Bureau of Mines Rept. of Investigations 3444, 1939, 13 pp.
[4] Probert, Frank H., Some Trends in Mining Practice: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 68–69.
[5] Parks, R. D., Mining Progress: Min. and Met., vol. 20, No. 385, January 1939, pp. 3–5.
[6] Schmitt, Harrison, Mining Geology Looks Toward Realism: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 69–73.
[7] Behre, Chas. H. Jr., Mining Geology: Min. and Met., vol. 20, No. 385, January 1939, pp. 16–18.
[8] Nicolson, C. W., Recent Improvements in the Mining Practice of the Tri-State District: Am. Inst. Min. and Met. Eng., Min. Technol., vol. 2, No. 3, May 1938, 17 pp.
[9] Engelmann, E. W., Ore Concentration and Gold Milling: Min. and Met., vol. 20, No. 365, January 1939, pp. 13–16.
[10] Fahrenwald, A. W., Older Ore Dressing Practices Restudied: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 73–75.

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of Mines.[11] The mill of the Hecla Mining Co. at Gem, Idaho, has been modernized and the capacity increased to 900 tons of ore per day.

*Smelting.*—According to Oldright,[12] advance in lead smelting during 1938 was confined to further development of previously established practice. The tendency toward adoption of wider sintering machines and efforts to increase the capacity of blast furnaces continued. Fleming [13] called attention to the fact that more than 500 tons of charge yielding a slag containing 20 percent zinc are now being treated daily in a standard-size blast furnace at Port Pirie. Formerly such tonnages were realized only when the zinc content was low. In refining lead the removal of bismuth always has been troublesome, particularly in producing corroding grades. The use of magnesium and potassium for this purpose has been proposed (United States Patent 2,133,327, October 18, 1938).

## WORLD ASPECTS OF LEAD INDUSTRY

*International cooperation.*—Unsatisfactory conditions in the lead industry during the latter part of 1938 culminated in a meeting of the principal foreign producers in London on September 6 at which the Lead Producers Association was formed. The official communique issued after the meeting gave few details but indicated that the object of the cartel was to restrict output to balance it more nearly with consumption and thus improve prices. According to press reports membership included producers in Australia, Burma, Yugoslavia, and Canada, as well as the American Smelting & Refining Co., which has extensive lead-mining interests in Mexico, Australia, and Newfoundland. This group represents 60 to 75 percent of the foreign lead production, and it is planned to invite other producers to participate in the scheme. Effective November 1 a 10-percent reduction in production was agreed upon with further curtailment to be declared if the market failed to improve. This was the first positive action taken to control the lead market since the International Association of Lead Producers collapsed in 1932 as a result of the imposition of an import duty on lead in the United Kingdom. However, world producers have cooperated in exchanging statistics for several years.

*World production.*—World smelter production of lead in 1938 fell 4 percent below the total for 1937 and was equivalent to 91 percent of the record output in 1929. The relatively good showing made in 1938 was due to the fact that output abroad was at the highest levels ever attained, slightly exceeding the previous record of 1937, although production in the United States declined 22 percent. The 10 principal producers and the percentage of the total output each contributed in 1938 were: United States 20, Australia 15, Mexico 13, Canada 11, Germany 11, Belgium 5, Burma 5, the U. S. S. R. 4, Italy 3, and France 3. Of the important lead-smelting countries, Australia showed an increase of 1 percent, Germany 6, Burma 3, the U. S. S. R. 13, Italy 11, and France 12. There was very little change in the Canadian rate of

[11] Clemmer, J. B., Duncan, W. E., DeVaney, F. D., and Guggenheim, M., Flotation of Southern Illinois Lead-Zinc-Fluorspar Ores: Bureau of Mines Rept. of Investigations 3437, 1939, 31 pp.
[12] Oldright, G. L., Lead Smelting Practice Advances: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 79–80.
[13] Fleming, E. P., Metallurgy of Lead: Min. and Met., vol. 20, No. 385, January 1939, pp. 20–21.

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activity, but output in the United States dropped 22 percent, that in Mexico 7 percent, and that in Belgium 9 percent. Of the smaller producers, Peru almost doubled its output, following a substantial increase in 1937, and Spain and Poland also registered notable gains. The British Empire produced about 508,000 metric tons of smelted lead in 1938, about the same quantity as in 1937. Since the 5-year period 1925–29, the Empire share of world output has advanced from 22 to 31 percent, whereas that of the United States has dropped from 42 to 20 percent. The share of the British Empire rose from 30 percent in 1937 to 31 percent in 1938, while that of the United States fell from 25 to 20 percent.

*World production of lead, 1934–38, in metric tons* [1]

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Argentina | 5,047 | 4,103 | 10,700 | 11,400 | (2) |
| Australia | 199,151 | 221,431 | 196,051 | 232,198 | 235,664 |
| Belgium | 74,750 | 68,980 | 67,000 | 93,310 | 84,600 |
| Burma | 71,692 | 73,217 | 74,329 | 77,728 | 80,166 |
| Canada | 142,635 | 148,558 | 164,857 | 181,162 | 181,783 |
| China | 1,665 | [3] 1,600 | [3] 1,600 | [3] 1,500 | (2) |
| Chosen | 1,806 | 1,728 | 2,738 | 5,850 | (2) |
| Czechoslovakia | 3,474 | 3,986 | 4,126 | 4,300 | 4,300 |
| France | 31,143 | 14,575 | 14,500 | 37,168 | 41,753 |
| Germany [4] | 119,980 | 122,300 | 139,000 | 162,400 | 171,700 |
| Austria | 5,629 | 8,048 | 8,732 | 10,836 | 9,280 |
| Greece | 8,023 | 4,679 | 4,172 | 5,890 | 4,535 |
| Hungary | 42 | 14 | 26 | 147 | (2) |
| Indochina | 15 | 18 | 12 | 8 | (2) |
| Italy | 47,397 | 35,803 | 36,307 | 38,938 | 43,310 |
| Japan | 7,039 | 7,442 | 8,883 | 10,200 | 12,000 |
| Mexico | 165,416 | 177,630 | 214,376 | 223,678 | 207,075 |
| Northern Rhodesia | 187 | 185 | 305 | 568 | 277 |
| Norway | 333 | 577 | 227 | 236 | (2) |
| Peru | 1,536 | 6,452 | 8,899 | 15,787 | 28,478 |
| Poland | 10,350 | 18,819 | 15,021 | 17,587 | 19,973 |
| Portugal | 54 | | | | |
| Rumania | 4,382 | 4,557 | 4,783 | 6,725 | (2) |
| South-West Africa | | | | 1,355 | 3,214 |
| Spain | 72,151 | 62,742 | 46,600 | 30,000 | 36,000 |
| Tunisia | 27,311 | 25,390 | 21,497 | 24,758 | 23,790 |
| Union of South Africa | | | | | 19 |
| U. S. S. R. | 27,174 | 44,853 | 50,800 | [3] 55,000 | [3] 62,000 |
| United Kingdom | 9,100 | 22,350 | 13,800 | 10,313 | 9,847 |
| United States (refined) [5] | 281,300 | 294,075 | 362,055 | 423,232 | 330,963 |
| Yugoslavia | 9,803 | 7,554 | 5,804 | 4,038 | 8,646 |
| | 1,329,000 | 1,382,000 | 1,477,000 | 1,686,000 | [3] 1,625,000 |

[1] By countries where smelted but not necessarily refined.
[2] Data not yet available. Estimate included in total.
[3] Approximate production.
[4] Exclusive of secondary material (Metallgesellschaft, Frankfort on the Main).
[5] Figures cover lead refined from domestic and foreign ore; refined lead produced from foreign base bullion not included.

*World consumption.*—The American Bureau of Metal Statistics reports world consumption of lead in 1938 as 1,634,600 metric tons, a decrease of 6 percent from the peak of 1937 but, except for 1937 and 1929, the highest ever registered. Record-breaking consumption abroad, where the total was 2 percent above the previous high in 1937, partly offset the drop of 26 percent in consumption in the United States. Compared with the estimated use of lead in 1929 consumption in the United States declined 45 percent, while that in the rest of the world increased 24 percent. In 1938 the United Kingdom consumed more lead than ever before and supplanted the United States

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as the principal lead-consuming country of the world, using 24 percent of the total. The United States used 22, Germany 15, Japan 6, U. S. S. R. 6, France 5, Italy 3, and the Netherlands, Belgium, Australia, New Zealand, and Sweden, about 2 percent each.

## REVIEW BY COUNTRIES

*Australia.*—The small increase in smelter output in 1938 was due to the larger production of Mount Isa which rose from 38,460 long tons in 1937 to 41,512 in 1938. Output at Port Pirie was approximately 190,000 tons in both years.

At Broken Hill production of crude ore increased from 1,468,000 tons in 1937 to an estimated 1,545,000 tons in 1938. The New Broken Hill mine is expected to begin production in 1940. Enlargement of facilities at the adjoining property of Zinc Corporation, Ltd., which is to treat the ore from the North Broken Hill mine, continued during 1938. North Broken Hill, Ltd., began operation of its new 50,000-ton-per-month concentrator in April 1939. The Broken Hill Proprietary mine was closed owing to exhaustion in February 1939. During a life of over 50 years the mine had produced 1,445,000 tons of lead and 189,457,000 ounces of silver.

The Lake George mine began producing in January 1939 when its new 500-ton-per-day mill was started. The ore contains approximately 8 percent lead, 12 percent zinc, and 2.5 ounces of silver per ton. A second 500-ton unit is planned.

Exports of lead ore and concentrates totaled 36,000 tons in 1938 compared with 34,500 in 1937. Exports of base bullion and refined lead declined from 203,000 to 195,000 tons. The metal went chiefly to Europe; Japan's purchases declined from 5,300 to 1,100 tons.

*Belgium.*—Smelter production of lead, which fell 9 percent from the peak established in 1937, is based on foreign ore, imports of which fell from 133,000 metric tons in 1937 to 107,000 in 1938. There were sharp declines in receipts from Yugoslavia, Sweden, Peru, and Canada, but shipments from Argentina and Bolivia increased. Imports of pig lead totaled 28,000 tons (mostly from Mexico), a slight advance over 1937. Exports of pig lead dropped from 68,000 to 67,000 tons. Loss of markets in France and Germany was largely offset by improved sales to the Netherlands.

Production of lead ore near Kengere (Katanga, Belgian Congo) is being stepped up, and monthly shipments to the smelter at Hoboken, Belgium, are anticipated. Belgian imports from this source were 6,400 tons in 1938.

*Burma.*—The Burma Corporation, Ltd., produced 99,773 long tons of lead concentrates containing 65 percent lead and 42 ounces of silver per ton compared with 107,073 tons containing 66 percent lead and 45 ounces of silver in 1937. The output of refined lead, however, increased from 76,500 to 78,900 tons and that of antimonial lead from 1,150 to 1,200 tons. In 1938, 5,920,000 ounces of refined silver were recovered compared with 6,180,000 ounces in 1937.

*Canada.*—Mine production of lead increased from 206,000 to 209,500 short tons. British Columbia produced nearly 99 percent of the 1938 total and the Yukon Territory slightly over 1 percent. No production was reported from Quebec and Nova Scotia in 1938.

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At the Sullivan mine in British Columbia the concentrator treated 2,273,000 tons of ore which contained 15.83 percent combined lead and zinc and 4.02 ounces of silver per ton compared with 2,220,000 tons in 1937 which contained 16.46 percent lead and zinc and 4.2 ounces of silver. The smelter produced 211,500 tons of bullion compared with 204,700 tons in 1937. Smelter recoveries surpassed previous records, but mill recoveries were 0.50 percent below 1937. Costs were reduced slightly. The refinery produced 201,400 tons of refined lead and 9,764,000 ounces of silver. Net profits for 1938 were $6,214,000 compared with $14,670,000 in 1937. The lead plants at Trail were described by Huttl.[14]

Exports of pig lead fell from 177,000 to 155,000 tons. Shipments to Japan decreased from 43,000 to 17,000 tons, whereas those to the United Kingdom increased from 115,000 to 120,000 tons. The lead content of ore exported in 1938 was only 3,600 tons.

*France.*—Consumption of lead in France in 1938 is estimated at 86,000 metric tons, a 20-percent decrease from 1937. Smelter production was 12 percent higher, and imports of lead ore advanced from 43,000 to 52,000 tons, larger tonnages having been received chiefly from Morocco and Yugoslavia. Imports of pig lead declined from 73,000 to 47,000 tons, as shipments from Tunisia, Belgium, and Mexico decreased. In 1938, as in 1937, there were virtually no imports from Spain. Approximately 11,000 tons of lead ore were exported in 1937 and 1938.

The subsidy to French and French Colonial metal mines, suspended in October 1936 when prices were high, was reinstituted in June but apparently did not benefit lead producers during 1938.

*Germany.*—A 6-percent rise in smelter output was accompanied by an 11-percent increase in imports of lead ore from 127,000 metric tons in 1937 to 141,000 in 1938. If an average lead content of 65 percent is assumed, imported ore furnished more than 50 percent of the smelter production in 1938. Yugoslavia supplied 27 percent of the 1938 ore imports, Newfoundland 22 percent, Bolivia and Peru 21 percent, Australia 10 percent, and other countries 20 percent. Apparent consumption of lead increased from 235,300 to 246,500 tons and imports of pig lead from 73,300 to 75,300 tons. Mexico supplied 42,600 tons of pig lead in 1938 and Peru 8,400 tons.

In annexing Austria and Czechoslovakia, Germany acquired some lead resources but increased its dependence on foreign sources of supply. Austria's mine output was approximately equal to its consumption, but Czechoslovakia has been a net importer of 10,000 to 15,000 tons of lead annually. Active development of Austria's lead deposits is indicated by the announcement that the Bleiberger Bergwerks union has been absorbed into the raw-materials organization of the Four Year Plan. Production of lead and zinc ores and metallic lead is to be increased, and a detailed investigation of the lead-zinc resources of Karinthia and the eastern Alpine regions will be undertaken.

*Italy.*—Further progress was made in increasing the domestic production of lead ores, which advanced from 59,000 metric tons in 1937 to an estimated 66,000 tons in 1938. Smelter output thus rose 11 percent, while imports of lead ore increased only slightly—from 13,500

[14] Huttl, John B., Producing Lead at Trail: Eng. and Min. Jour., vol. 139, No. 6, June 1938, pp. 34–38.

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to 13,700 tons. Apparent consumption totaled 51,900 tons in 1938 compared with 50,400 tons in 1937, and imports of pig lead declined from 10,900 to 8,600 tons. The principal lead mines are in Sardinia, and efforts are being made to expand production there. Italy expects to be independent of foreign sources of lead by 1940. The deposits in the Arbus area in southwest Sardinia were described recently by Wright.[15]

*Japan.*—Because publication of statistics on the mineral industries has been discontinued, details of the lead industry in 1938 are not available. The American Bureau of Metal Statistics estimates consumption at 100,000 metric tons, a decrease of 20,000 tons from 1937. This sharp decline is substantiated by the reduction in exports to Japan from Canada and Australia.

Japan imports over 90 percent of its lead, and because of the shortage of foreign exchange and the need of lead for military purposes its use in many other outlets has been restricted. On March 23, 1938, the importation of lead was placed under Government license, and on July 15 regulations were promulgated restricting the consumption of lead and other metals.

A Japanese company has been formed to develop lead, zinc, and copper mines at Tienpaushan, Chientao Province, Manchuria.

*Mexico.*—Mine production of lead increased from 218,133 metric tons in 1937 to 282,369 in 1938—29 percent; smelter output decreased 7 percent. Production of refined lead at the two refineries at Monterrey declined from 222,057 to 202,411 tons; the Penoles plant supplied 30 percent of the 1938 output and the A. S. & R. plant 70 percent. The latter was closed from November 18, 1938, to March 22, 1939, because of a strike. In August 1938 a 12-percent export tax was imposed on the appraised value of goods exported. Presumably this action was designed to give the Government the benefits accruing to exporters from the decline in the exchange value of the peso. The official value assigned for lead for the purpose of computing the tax was 0.98 cent per pound from August 10 to November 20, when it was increased to 1.10 cents.[16] As these values were substantially below world prices, the actual tax was considerably below 12 percent of the actual value of the metal exported. There has been no further news regarding the proposed lead smelter to treat labor-cooperative ores, mentioned in Minerals Yearbook, 1938.

Constantly increasing taxes and demands of labor have created hardships for many companies operating in Mexico. This is illustrated vividly by the following remarks of the chairman of the San Francisco Mines of Mexico, Ltd., at the shareholders' meeting in February 1938.

> In short, the technical position at the mine continues to be satisfactory. In order to maintain this position, however, a very active development program must be carried out, and we hope that the Mexican Government and Mexican labor will in their own interests do all they can to assist us in this.
>
> This brings me to labor. Our new collective contract was signed on the 26th February, 1937, but was retrospective to the 5th November, 1936, so that for 11 months of the year we were paying the higher rates. With its signature we had hoped we should be allowed at least a short period in which to carry on our operations without labor interference. I am sorry to say that this has not been the

[15] Wright, Charles Will, The Lead-Zinc Deposits and Geology of the Arbus Area in Sardinia, Italy: Econ. Geol., vol. 34, No. 1, January–February 1939, p. 82.

[16] Hubbell, A. H., Mexico: Eng. and Min. Jour., vol. 140, No. 2, February 1939, p. 60.

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case. It is true that the collective contract has not been upset, but we have been continually subjected to demands from labor, strike threats, incipient sit-down strikes, ore thefts, interference in management, and a general lessening of efficiency and discipline throughout the organization. At this very moment there is a sit-down strike of 1 hour daily for some unspecified reason. The executives at the mine, who anyway have a full-time job looking after the technical work, have had to devote much of their time and a great deal of overtime to handling labor matters. Inefficient labor and harassed officials must have an effect on operations. Conditions are now such that the company cannot bear further burdens, and accordingly I speak with the utmost frankness.

As I said before, the mine is now virtually being run for the employees. One hears in Mexico of talk of expropriation, but in the case of mining I believe the Mexican Government realizes that the Government itself or the Sindicatos could not run the mine as efficiently as can a technical staff highly skilled at the job and with long experience of the mine. In other words, under its present highly skilled management the mine has its best chance of weathering this stormy period of low metal prices. But the Mexican Government and Mexican labor must surely realize that shareholders, management, and British financial interests will not be content to give their cooperation if the reward is inadequate. It is not sufficient that the reward should only be forthcoming when base metals are at peak prices.

It should be borne in mind that the burden placed upon us by increased wages, social legislation and Government, and labor interference with operations does not finish the story. Cost of supplies, import duties, railway freights, loading charges at port, metal productions tax, salaries, and, in fact, nearly everything which enters into our costs of production have been stepped up.

*Newfoundland.*—Approximately 459,000 short tons of lead-zinc ore were milled during 1938, which yielded 47,100 tons of lead concentrates containing 27,400 tons of lead and 487,000 ounces of silver; 41,400 tons of concentrate were produced in 1937 and 46,000 tons in 1936.

*Peru.*—Exports of lead ore declined from 24,600 metric tons in 1937 to 18,800 in 1938, whereas shipments of concentrates increased from 22,000 to 34,000 tons and of refined lead from 15,800 to 28,500 tons. The Cerro de Pasco Copper Corporation increased its lead output from 19,000 to 26,000 tons.

*Spain.*—Owing to the civil war little information as to activity at Spanish lead mines has been available. However, in May 1938 it was reported that the Renteria smelter, which treats the lead concentrates from the Reocin mine, Santander, was producing at the rate of 5,000 tons annually. The lead mines of Linares, Cartagena, Magarron, and Jaen were in Government territory and those at Penarroya, Malaga, Cordoba, and Reocin in Nationalist territory throughout most of 1938.

*United Kingdom.*—Consumption of pig lead, as estimated by the British Metal Corporation, Ltd., totaled 344,000 long tons in 1938 compared with 337,000 tons in 1937. Of the 1938 total, 58 percent was used in sheet and pipe, white lead, oxides, etc.; 27 percent in cable; 7 percent in batteries; and 8 percent for miscellaneous purposes. The use of lead in cable and batteries increased 18 and 14 percent, respectively, over 1937, whereas its use in the other two items declined. Stocks of lead in official warehouses increased from 7,000 tons on January 1 to 11,000 on December 31, 1938. Only 3 percent of the domestic requirements was supplied by local smelters. Imports of pig lead increased from 373,000 tons in 1937 to 407,000 in 1938; 88 percent of the 1938 total was obtained from Australia, Canada, and Burma and the remainder chiefly from Mexico. Mexican shipments

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ropped from 44,500 to 41,500 tons. Reexports of pig lead decreased rom 37,000 to 25,000 tons, and exports of lead and lead manufactures ose slightly from 13,500 to 14,500 tons.

Despite the lower prices for lead in 1938, mine output was mainained at 38,100 tons of 78-percent concentrates compared with 9,100 tons in 1937. Some concentrate is exported to continental melters. Exploration of old lead mines in the vicinity of Eyam, )erbyshire, is under way.

*Yugoslavia.*—Exports of lead concentrates again increased, totaling 9,500 metric tons in 1938 compared with 84,400 tons in 1937; Belgium ook 70 percent of the 1938 shipments. Trepca Mines, Ltd., treated 55,892 tons of ore in the fiscal year ended September 30, 1938, com-)ared with 638,729 tons in the previous fiscal year. Production of ead concentrates (79 percent lead) increased from 70,500 to 73,000 ons. Mill recoveries of more than 97 percent are being obtained. n August 1938 the properties of the Kapaonik, Zletovo, and Novo Brdo companies were absorbed by Trepca Mines, Ltd. An agreement ias been made with the Government whereby Trepca, through a ubsidiary company, will build a lead smelter at Zvecan. Initial nnual capacity of the plant is to be 12,000 tons of metal, but it is xpected that by 1941 the entire lead output of the Trepca group ill be smelted in Yugoslavia.

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# ZINC [1]

By E. W. Pehrson

## SUMMARY OUTLINE


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The statistical record indicates that the zinc industry experienced an unsatisfactory year in 1938. Smelter production from domestic ores declined 21 percent compared with 1937, apparent consumption was a third less, producers' stocks at the end of the year nearly doubled, and the average price at St. Louis declined almost 2 cents per pound. During the first 6 months domestic shipments were 45 percent below the average rate for 1937. As production was not reduced proportionately, stocks soared and prices dropped. By the end of June producers' stocks exceeded the depression high established in 1930, and in May prices fell to the lowest level since April 1935. Beginning in May, however, business improved steadily; by November shipments more than doubled those for the low point reached in April, and there was a substantial decline in inventories. Prices also improved, but the advance was restricted by the unsettled market in London and falling sterling exchange rates. The St. Louis quotation for prime western zinc fell from 5.00 cents at the beginning of the year to 4.00 cents in May but rose to 5.05 cents about the middle of October where it stayed until November 21. Two price cuts during the latter part of November lowered the quotation to 4.50 cents, where it remained throughout December, in which month deliveries to consumers declined and stocks again increased. From April to November 15 the differential between New York and London prices increased from 1.50 to 2.42 cents per pound; at the close of the year the differential was 1.98 cents. Imports were much lower in 1938, having declined 81 percent from the peak established in 1937, when a threatened shortage of domestic metal due to temporary conditions prompted large purchases abroad.

[1] This report deals primarily with the smelting branch of the industry. Full details of zinc mining are given in the various State reports. Some zinc ore is used directly in the manufacture of zinc pigments. (See chapter on Lead and Zinc Pigments and Zinc Salts.)



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*Salient statistics of the zinc industry in the United States, 1925–29 (average) and 1934–38*

| | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Production of primary slab zinc: | | | | | | |
| By sources: | | | | | | |
| From domestic ores...short tons | 589,648 | 355,366 | 412,184 | 491,803 | 551,165 | 436,007 |
| From foreign ores...do | 12,734 | 8,224 | 8,450 | 329 | 5,739 | 10,334 |
| | 602,382 | 363,590 | 420,634 | 492,132 | 556,904 | 446,341 |
| By methods: | | | | | | |
| Electrolytic...percent of total | 21 | 21 | 28 | 26 | 21 | 21 |
| Distilled...do | 79 | 79 | 72 | 74 | 79 | 79 |
| Production of redistilled secondary slab zinc...short tons | 43,756 | 19,691 | 28,650 | 42,209 | 51,554 | 31,613 |
| Stocks on hand at primary smelters Dec. 31...short tons | 45,575 | 124,783 | 90,539 | 55,500 | 79,144 | 157,511 |
| Primary zinc available for consumption...short tons | 548,472 | 345,914 | 457,705 | 538,794 | 570,219 | 375,004 |
| Price—prime western at St. Louis: | | | | | | |
| Average for year...cents per pound | 6.76 | 4.16 | 4.33 | 4.90 | 6.52 | 4.61 |
| Highest quotation...do | 8.90 | 4.40 | 4.95 | 5.45 | 7.50 | 5.05 |
| Lowest quotation...do | 5.40 | 3.67½ | 3.70 | 4.75 | 5.00 | 4.00 |
| Price—yearly average at London...do | 6.46 | 3.07 | 3.08 | 3.31 | 4.91 | 3.05 |
| Mine production of recoverable zinc...short tons | 724,720 | 438,726 | 517,903 | 575,574 | 626,362 | 516,699 |
| Tri-State district (Joplin)...percent of total | 49 | 35 | 37 | 39 | 38 | 38 |
| Western States...do | 30 | 29 | 31 | 31 | 31 | 28 |
| Other...do | 21 | 36 | 32 | 30 | 31 | 34 |
| World smelter production of zinc...short tons | 1,435,000 | 1,287,000 | 1,467,000 | 1,608,000 | 1,785,000 | 1,717,000 |

The outstanding event of the year was the announcement of a 20-percent reduction in the tariff on zinc and zinc ores effective January 1, 1939. Under the Canadian Trade Agreement signed November 17 the new duty on slab zinc was fixed at 1.40 cents per pound, a reduction of 0.35 cent from the previous rate of 1.75 cents in effect since 1922. Owing to the surplus of foreign zinc in recent years, London prices have been depressed to such an extent that domestic producers frequently have been threatened with loss of domestic markets through importation. As the old tariff has been nearly 100 percent effective during this period, it follows that the reduction in duty will have to be absorbed by domestic producers if they are to maintain their position in the home market. According to trade authorities this was done on November 21, 1938, when domestic quotations were cut 0.30 cent per pound.

Figure 1 shows trends in the domestic zinc industry since 1900.

Outside the United States apparent consumption increased 3 percent to a new all-time record. Armament probably has accounted for a large part of the increase in foreign consumption of zinc in recent years. It is interesting to note that Germany, Japan, and the U. S. S. R. recorded further increases in 1938, whereas the United Kingdom and France scored decreases. Production abroad likewise continued its steady rise of the previous 5 years and established a new high record. Supply exceeded demand, there were further accretions to producers' stocks of metallic zinc, and large quantities of concentrates are said to be held at the mines. As a consequence of the superabundance of zinc London quotations in sterling sagged to the lowest yearly average since 1933, reaching an extremely low level early in June. Some improvement was noticeable in the last

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half of the year, but this was offset to a considerable extent by a substantial drop in the foreign exchange value of the pound. Low prices stimulated efforts to revive the Zinc Cartel, but such efforts proved to be fruitless, and at the end of the year the outlook for any relief through cooperative action was dismal.

*Reduction in tariff.*—The 20-percent reduction in the import duty on zinc resulting from the Canadian Trade Agreement signed November 17, 1938, aggravated the already unfavorable competitive position of the domestic zinc industry. As stated in Minerals Yearbook, 1938, domestic producers are at a disadvantage in comparison with foreign producers because of the lower grade of ore found in domestic deposits.

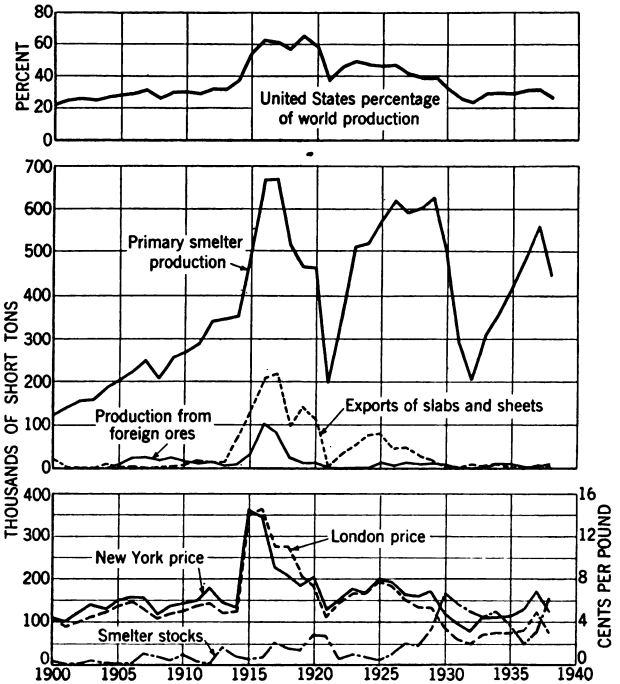


FIGURE 1.—Trends in the zinc industry in the United States, 1900-1938. Imports of slab and sheet zinc are not shown, as they seldom exceed 500 tons annually. In the last few years, however, they have increased, amounting to 11,902 tons in 1936, 37,439 in 1937, and 7,456 in 1938.

Costs of production in the United States also are influenced by higher wage rates in this country. Formerly these basic disadvantages were offset partly by superior technology and mechanization, but in recent years American mining practice has been adopted abroad, particularly at several properties that have begun production in the last decade, and foreign costs of production have been reduced accordingly. The increased output of these new mines has been augmented by subsidized production from submarginal deposits in various countries striving for self-sufficiency and by increased capacity and improved recovery at older mines, all of which have resulted in considerable overproduction. Stocks of both ore and metal have accumulated at mines and smelters with depressing effects on world prices.

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During the 10-year period 1920–29 the London quotation for prompt metal averaged 6.3 cents per pound. Since then the average has been 3.2 cents, almost a 50-percent decline. New York quotations for the same periods averaged 6.9 cents and 4.8 cents, respectively. That the tariff has been highly effective since 1929 is indicated by the rise of 0.6 cent to 1.6 cents per pound in the average differential between New York and London prices.

Despite the fact that the previous tariff prevented a more drastic drop in domestic prices, zinc mining in many districts of the United States has not been profitable enough in recent years to induce adequate expenditure for exploration and development needed to maintain ore reserves; thus the basic position of the industry has been jeopardized by lack of proper provision for its future. As a consequence some domestic producers considered requesting Congress for further tariff protection as early as 1936 when events abroad prevented the New York quotation from rising above 5.25 cents. Action was postponed, however, by the rise in prices during the extraordinary boom in metals late in 1936 and early in 1937 and by the temporary shortage of zinc in the summer of 1937. After the sharp recession of prices in 1938 the industry was facing the same outlook as in 1936 with the added handicap of a 20-percent cut in its tariff protection.

The ultimate effects of the tariff reduction on the domestic zinc industry cannot be determined at this time. As the previous import duty (1.75 cents per pound) was virtually 100 percent effective prior to the announcement of the Canadian Trade Agreement, it is obvious that to avoid large imports of foreign metal, the domestic price of zinc must be reduced in relation to London prices by approximately the amount the import duty was cut. An immediate effect of the reduction, therefore, has been aggravation of an already serious condition that has resulted from and will continue as long as the depressed market exists abroad.

A review of the present status of foreign production indicates that the foreign price of zinc will remain below predepression averages for an extended period. During the last several years large new producers in Yugoslavia, Newfoundland, northern Spain, Australia, and Canada have come into the market. At most of these properties zinc concentrates are produced largely as a byproduct, and the cost of mining and milling the crude ore is borne by other products, principally lead and silver. Consequently the out-of-pocket cost of zinc concentrates is relatively low because it comprises only the expense of separating the zinc minerals after the ore is mined and crushed. Producers are thus content to sell the zinc at a price that yields a profit over the out-of-pocket cost.

Notwithstanding the low level of prices and the overabundance of present foreign capacity, plans are under way for increasing capacity at several properties, and new mines are being developed. The practice of subsidizing submarginal mines continues to expand, particularly in Germany. The world's demand for zinc evidently can be supplied for many years at prices far below former averages. This conclusion is substantiated by the fact that, except during the boom in 1937, world prices have not returned to predepression levels, although foreign consumption has increased steadily since 1932 and has established new peaks during the past 4 years. In 1938 foreign consumption of zinc was 20 percent greater than in 1929, yet the

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average London price was only 3.05 cents per pound compared with 5.40 cents in 1929.

Much of the advance in consumption has been due to military preparations engendered by the tense international situation. Should the situation be settled without resort to war the demand for zinc for munitions probably would end abruptly. Substantial quantities of zinc now on hand in matériel might be thrown on the market as scrap, which would add to the present excess.

If all factors are considered the outlook for prices satisfactory to the domestic zinc industry is unfavorable owing to the situation in the foreign market. Substantial improvement there depends primarily on the extent to which producers can cooperate to avoid overproduction. Failure of the various attempts to reestablish the Zinc Cartel since it collapsed in 1934 offers little hope of immediate success in this direction. The recent large increase in the import duty on non-British zinc in the United Kingdom, the self-sufficiency programs of various nations, the shortage of foreign exchange, and the intense competition for the remaining open markets appear to be almost insurmountable obstacles.

If the domestic industry is to continue to supply national requirements it must become adjusted to the lower price level, to which has been added a reduction of 0.35 cent per pound in tariff protection. To do this, costs of production will have to be reduced, chiefly by lowering wages and by selective mining of the higher grade portions of ore deposits, neither of which is desirable. Reduction of wages is contrary to present Government policies of increasing purchasing power, and the robbing of ore bodies is decidedly anticonservational and detrimental to the long-time welfare of the industry.

The alternative would be loss of part of the domestic zinc market to foreign producers. From the standpoint of public interest this likewise would be undesirable because it would aggravate the unemployment problem. Dr. John W. Finch, Director of the Bureau of Mines, has pointed out that it would also be undesirable from the standpoint of national defense. In an address on strategic minerals at the annual meeting of the American Zinc Institute at St. Louis in April 1938 he emphasized the importance of preserving industries that now provide self-sufficiency in important industrial minerals, as follows:

> In this connection I should like to suggest that a reduction in the present tariff on lead and zinc can hardly be considered in the public interest if viewed from the standpoint of national defense. The fact that these metals are produced in large quantities in neighboring countries is not adequate protection, as we have no assurance that supplies could be obtained from these countries in an emergency except at exorbitant cost or by military effort. It seems to me that the maintenance of the security afforded by our ability to supply our own needs of these important industrial raw materials should receive careful consideration.

In the past 12 months the domestic zinc industry has suffered drastic curtailment. Several mines and one smelter, which resumed operations in 1937 after protracted shut-downs, were forced to close again in 1938 on account of low prices. It has been reported that production has continued at many mines in the Tri-State area where the selling price of the product covered operating costs without provisions for depletion, depreciation, or adequate return on capital investment. There were further shut-downs during 1939. Early in May the American Zinc Lead & Smelting Co. notified its employees



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of its intention to discontinue operation of the slab-zinc division of its East St. Louis smelter, probably before the end of the second quarter of the year. It was stated that this would be the first time that this division has been entirely closed since it was built and put into operation in 1914. According to the company this action was predicated on increased operating costs brought about in the last 3 years by the increased costs of labor, fuel, supplies, and taxes, which make it impossible to operate under current prices for zinc. Later in May, the United Zinc Co., Moundsville, W. Va., announced that effective June 1 a 10-percent cut in salaries and wages would be imposed because of the serious financial condition of the company. According to press reports the workers declined to accept the cut, preferring to go into an unemployed status. The plant was closed on June 1 for an indefinite period.

Import statistics for the first 4 months of 1939 indicate that the quantity of slab zinc entered for consumption totaled 9,350 tons compared with 1,782 tons in the same period of 1938. Information is not available as to how much of this metal eventually will be exported in manufactures with benefit of draw-back. Nevertheless, the large increase in imports in 1939 suggests that substantial quantities of foreign zinc may be invading domestic markets.

The foregoing analysis of the zinc industry indicates clearly that domestic producers are confronted with a critical situation as a result primarily of unsatisfactory conditions abroad. Their effects on the domestic market have been intensified by the 20-percent reduction in tariff.

Since the terms of the Canadian Trade Agreement were made public, representatives of the zinc industry have protested vigorously the reduction in the duty on zinc and have urged the Government to restore the tariff to its former level. This can be accomplished either by the State Department or by Congress. The State Department could initiate action under the provision in the trade agreement that gives each country the right to withdraw or modify the concession granted on any article—

> * * * If, as the result of the extension of such concession to other foreign countries, such countries obtain the major benefit of the concession, and if in consequence imports of the article concerned increase to such an extent as to threaten serious injury to domestic producers.

The State Department has been studying the situation in detail with a view to determining whether the actual effects of the tariff reduction merit such action. Congress could restore the tariff to its former level by legislative enactment, and a bill to do this has been introduced in the present session. It is understood, however, that Congress is reluctant to inaugurate action to restore specific reductions in the various trade agreements by such means as eventually it might vitiate the entire reciprocal-trade-treaty program.

## DOMESTIC PRODUCTION

*Production of primary and secondary slab zinc.*—Production of primary slab zinc from domestic and foreign ores in 1938 declined 20 percent from 1937, was equivalent to 74 percent of the average output for the 5-year period 1925–29, but exceeded by 115 percent the depression low established in 1932.

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Production from domestic sources decreased 21 percent, whereas that from foreign sources increased 80 percent. Foreign ores smelted in 1938 were obtained almost entirely from Peru and Mexico.

Production of secondary slab zinc fell off 35 percent from 1937. Statistics on remelted secondary zinc for 1937 have been revised, and those for prior years are being revised because some producers of redistilled metal inadvertently have been reporting their production as remelted metal also. Former statistics on production of remelted zinc thus have overstated the actual output of this type of metal.

*Primary and secondary slab zinc produced in the United States, 1934–38, in short tons*

| Year | Primary | | | Secondary | | | Grand total |
|---|---|---|---|---|---|---|---|
| | Domestic | Foreign [1] | Total | Redistilled | Remelted | Total | |
| 1934 | 355,366 | 8,224 | 363,590 | 19,691 | (2) | (2) | (2) |
| 1935 | 412,184 | 8,450 | 420,634 | 28,650 | (2) | (2) | (2) |
| 1936 | 491,803 | 329 | 492,132 | 42,209 | (2) | (2) | (2) |
| 1937 | 551,165 | 5,739 | 556,904 | 51,554 | [3] 12,986 | [3] 64,540 | [3] 621,444 |
| 1938 | 436,007 | 10,334 | 446,341 | 31,613 | 10,657 | 42,270 | 488,611 |

[1] All foreign zinc smelted in the United States in 1934–36 was derived from Mexican ores; in 1937–38, most of it originated in Peru.
[2] Figures in process of revision.
[3] Revised figures.

*Distilled and electrolytic zinc.*—Of the total output of primary zinc in 1938, 79 percent was distilled and 21 percent electrolytic. Production of distilled primary zinc declined 20 percent and that of electrolytic zinc 21 percent. The production of redistilled secondary zinc dropped 39 percent; large decreases occurred at both primary and secondary smelters.

*Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1934–38, in short tons*

APPORTIONED ACCORDING TO METHOD OF REDUCTION

| Year | Electrolytic primary | Distilled primary | Redistilled secondary [1] | | Total |
|---|---|---|---|---|---|
| | | | At primary smelters | At secondary smelters | |
| 1934 | 76,657 | 286,933 | 4,962 | 14,729 | 383,281 |
| 1935 | 118,476 | 302,158 | 13,439 | 15,211 | 449,284 |
| 1936 | 127,175 | 364,957 | 22,142 | 20,067 | 534,341 |
| 1937 | 117,511 | 439,393 | 24,131 | 27,423 | 608,458 |
| 1938 | 93,272 | 353,069 | 14,003 | 17,610 | 477,954 |

APPORTIONED ACCORDING TO GRADE

| Year | Grade A (high-grade) | Grade B (intermediate) | Grade C (brass special) | Grade D (selected) | Grade E (prime western) | Total |
|---|---|---|---|---|---|---|
| 1934 | 116,720 | 32,621 | 43,657 | | 190,283 | 383,281 |
| 1935 | 155,516 | 49,118 | 49,909 | | 194,741 | 449,284 |
| 1936 | 183,841 | 59,879 | 65,728 | | 224,893 | 534,341 |
| 1937 | 196,052 | 67,132 | 72,993 | | 272,281 | 608,458 |
| 1938 | 140,256 | 58,128 | 73,724 | | 205,846 | 477,954 |

[1] For total production of secondary zinc see chapter on Secondary Metals—Nonferrous.

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*Production of primary slab zinc by States.*—Pennsylvania continued to be the leading producer of primary slab zinc, Montana replaced Oklahoma in second place, and Illinois again ranked fourth. The output of West Virginia and Texas is shown under "Other States." Production from all States decreased in 1938. All the production in Montana and Idaho is electrolytic zinc, whereas the other States shown produce only distilled zinc.

*Primary slab zinc produced in the United States, by States, 1934–38, in short ton*

| Year | Arkansas | Idaho | Illinois | Montana | Oklahoma | Pennsylvania | Other States [1] | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Short tons | Value |
| 1934 | 11,808 | 9,935 | 55,773 | 66,722 | 61,711 | 100,728 | 56,913 | 363,590 | $31,269,00 |
| 1935 | 10,147 | 12,448 | 67,348 | 106,028 | 58,612 | 119,452 | 46,599 | 420,634 | 37,016,00 |
| 1936 | 18,005 | 21,223 | 81,174 | 105,952 | 62,963 | 150,425 | 52,390 | 492,132 | 49,213,00 |
| 1937 | 25,799 | 22,831 | 73,151 | 94,680 | 96,153 | 175,275 | 69,015 | 556,904 | 72,398,00 |
| 1938 | 20,476 | 15,634 | 68,167 | 77,638 | 68,224 | 139,897 | 56,305 | 446,341 | 42,849,00 |

[1] Texas and West Virginia.

*Secondary zinc.*—Besides the redistilled and remelted secondary slab zinc (unalloyed) mentioned previously, a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Details are given in the chapter on Secondary Metals—Nonferrous.

*Byproduct sulfuric acid.*—An important byproduct of zinc smelting is sulfuric acid made from the sulfur dioxide gases evolved from the roasting of zinc blende. Some plants also consume large quantities of sulfur in addition to blende to utilize a larger proportion of their acid-producing capacity. The following table shows the production of sulfuric acid at zinc-blende roasting plants from 1933 to 1937. Data for 1938 are not yet available.

*Sulfuric acid (60° B. basis) made at zinc-blende roasting plants in the United States, 1933–37* [1]

| Year | Made from zinc blende | | Made from sulfur | | Total | | |
|---|---|---|---|---|---|---|---|
| | Short tons | Value [2] | Short tons | Value [2] | Short tons | Value [2] | |
| | | | | | | Total | Average per ton |
| 1933 | 355,027 | $2,676,904 | 242,493 | $1,828,397 | 597,520 | $4,505,301 | $7.54 |
| 1934 | [3] 406,984 | 3,215,173 | 89,162 | 704,380 | 496,146 | 3,919,553 | 7.90 |
| 1935 | [3] 443,476 | 3,756,242 | 90,884 | 769,787 | 534,360 | 4,526,029 | 8.47 |
| 1936 | 505,882 | 4,497,291 | 161,169 | 1,432,792 | 667,051 | 5,930,083 | 8.89 |
| 1937 | [3] 542,356 | 5,060,181 | 151,090 | 1,409,670 | 693,446 | 6,469,851 | 9.33 |

[1] Figures for 1938 not yet available.
[2] At average of sales of 60° acid.
[3] Includes acid from small quantity of foreign blende.

*Rolled zinc.*—Production of rolled zinc in 1938 decreased 21 percent from 1937. Some producers fabricate their rolled zinc into various products, and the scrap resulting from these operations is remelted and rerolled. In 1938 the scrap so treated amounted to 9,392 tons compared with 11,062 in 1937. Zinc lost in waste products, such as

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skimmings and drosses and pot losses, totaled 1,150 tons in 1938—equivalent to about 3 percent of the net production of rolled zinc. Of the zinc purchased for rolling in 1938, 38 percent was brass special, 32 percent prime western, 14 percent selected, 14 percent high grade, and 2 percent electrolytic and intermediate grades. Stocks of slab zinc on hand at zinc-rolling mills were about 9,600 tons at the beginning and about 7,600 tons at the end of the year.

*Rolled zinc produced and quantity available for consumption in the United States, 1937–38*

| | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average per pound | | Total | Average per pound |
| Production: | | | | | | |
| Sheet zinc not over 0.1 inch thick | 15,489 | $3,604,000 | $0.116 | 12,219 | $2,503,000 | $0.102 |
| Boiler plate and sheets over 0.1 inch thick | 1,223 | 228,000 | .093 | 829 | 145,000 | .087 |
| Strip and ribbon zinc [1] | 41,384 | 7,434,000 | .090 | 32,827 | 5,278,000 | .080 |
| Total zinc rolled [1] | 58,096 | 11,266,000 | .097 | 45,875 | 7,926,000 | .086 |
| Imports | 231 | 30,000 | | 226 | 26,000 | |
| Exports | 5,813 | 1,104,000 | .095 | [2] 5,736 | [2] 908,000 | .079 |
| Available for consumption | 52,514 | | | 40,365 | | |
| Value of slab zinc (all grades) | | | .065 | | | .048 |
| Value added by rolling | | | .032 | | | .038 |

[1] Figures represent net production. In addition, 11,062 tons of strip and ribbon zinc in 1937 and 9,392 tons of strip and ribbon zinc in 1938 were rerolled from scrap originating in fabricating plants operated in connection with zinc-rolling mills.
[2] Includes some slab zinc; not separately recorded.

*Zinc dust.*—The output of zinc dust decreased 24 percent from 1937, the peak year. The zinc content of dust produced in 1938 ranged from 94 to 98.5 percent and averaged 97 percent. Since 1931 virtually all zinc dust has been produced by redistillation of zinc drosses and slab zinc.

*Zinc dust [1] produced in the United States, 1934–38*

| Year | Short tons | Value | | Year | Short tons | Value | |
|---|---|---|---|---|---|---|---|
| | | Total | Average per pound | | | Total | Average per pound |
| 1934 | 10,856 | $1,342,133 | $0.062 | 1937 | 15,242 | $2,587,577 | $0.085 |
| 1935 | 12,453 | 1,574,259 | .063 | 1938 | 11,609 | 1,542,511 | .066 |
| 1936 | 14,425 | 1,957,300 | .068 | | | | |

[1] All produced by distillation.

*Zinc pigments and salts.*—Zinc oxide, leaded zinc oxide, and lithopone are the principal pigments of zinc and chloride and sulfate the principal salts. These products are manufactured from various zinciferous materials—ores, metal, and secondary substances. Details of the production of zinc pigments and salts are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

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*Mine production.*—Mine production decreased 18 percent in 1938. The Western States suffered the largest decline in both tonnage and percentage, the latter amounting to 25 percent. The reduction in tonnage in the Central States was almost as large, a 19-percent drop in output being recorded. Production in the Eastern States declined only 9 percent; declines in New Jersey and New York were offset in part by increases in Virginia and Tennessee.

Of interest in the Western States are the gains in Washington and New Mexico. The gain in Washington resulted from increased production at two mines in the Metaline district, one of which shut down about midyear after having begun production only in October 1937. New Mexico's increase was due mostly to expanded production in the Central district. Arizona and Colorado recorded smaller increases, but all other States showed major declines.

In the Central States the Tri-State region produced 17 percent less zinc in 1938 than in 1937. The output in 1938 was equivalent to only 55 percent of the average yearly output from 1925 to 1929. The district supplied 38 percent of the total zinc produced in the United States in 1938 compared with 49 percent in the predepression 5-year period, 1925–29. The marginal nature of production in Wisconsin is indicated by the 70 percent decline in that State.

Further details of zinc mining will be found in the various State reports in this volume.

*Mine production of recoverable zinc in the United States, 1925–29 (average) and 1934–38, in short tons*

| State | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Western States: | | | | | | |
| Arizona | 2,628 | 905 | 3,337 | 3,589 | 5,026 | 5,814 |
| California | 3,999 | 361 | 161 | 8 | 20 | |
| Colorado | 32,868 | 772 | 1,202 | 1,172 | 4,247 | 4,553 |
| Idaho | 29,128 | 24,799 | 31,053 | 49,100 | 54,199 | 44,030 |
| Montana | 72,519 | 30,721 | 54,781 | 49,717 | 39,168 | 8,844 |
| Nevada | 5,570 | 13,940 | 15,536 | 13,477 | 14,236 | 8,940 |
| New Mexico | 23,351 | 26,522 | 22,126 | 20,668 | 23,927 | 28,236 |
| Oregon | | 37 | | 61 | 24 | |
| Utah | 44,385 | 28,198 | 31,107 | 36,192 | 48,001 | 33,658 |
| Washington | 575 | 1,926 | 1 | 4,403 | 4,116 | 11,402 |
| | 215,023 | 128,181 | 159,304 | 178,387 | 192,964 | 145,477 |
| Central States: | | | | | | |
| Arkansas | 71 | 68 | 153 | 182 | 241 | 152 |
| Illinois | 1,174 | | | | | |
| Kansas | 114,323 | 38,261 | 54,110 | 79,017 | 80,300 | 73,024 |
| Kentucky | 644 | 125 | 127 | 238 | 270 | 322 |
| Missouri | 16,708 | 7,059 | 7,263 | 18,709 | 20,600 | 10,226 |
| Oklahoma | 226,969 | 107,772 | 129,763 | 129,175 | 135,696 | 112,924 |
| Wisconsin | 23,055 | 9,807 | 8,923 | 8,126 | 6,938 | 2,073 |
| | 382,944 | 163,092 | 200,339 | 235,447 | 244,045 | 198,721 |
| Eastern States: | | | | | | |
| New Jersey | 93,839 | 76,553 | 85,708 | 89,883 | 101,408 | 85,839 |
| New York | 7,091 | 23,188 | 23,720 | 26,941 | 32,690 | 29,896 |
| Tennessee and Virginia [1] | 25,823 | 47,712 | 48,832 | 44,916 | 55,255 | 56,766 |
| | 126,753 | 147,453 | 158,260 | 161,740 | 189,353 | 172,501 |
| | 724,720 | 438,726 | 517,903 | 575,574 | 626,362 | 516,699 |

[1] Bureau of Mines not at liberty to publish figures for Tennessee and Virginia separately.

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*Mine production of recoverable zinc in the principal zinc-producing districts of the United States, 1934–38, in short tons*

| District | State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Joplin region | Kansas, Missouri, Oklahoma | 153,092 | 191,136 | 226,857 | 236,585 | 196,174 |
| New Jersey | New Jersey | 76,553 | 85,708 | 89,883 | 101,408 | 85,839 |
| Eastern Tennessee | Tennessee | 47,712 | 48,832 | 44,916 | 55,255 | 56,766 |
| Austinville | Virginia | | | | | |
| Coeur d'Alene region | Idaho | 24,799 | 31,009 | 44,310 | 47,070 | 31,937 |
| St. Lawrence County | New York | 23,188 | 23,720 | 26,941 | 32,690 | 29,896 |
| Bingham | Utah | 16,611 | 17,996 | 17,422 | 20,570 | 23,096 |
| Central | New Mexico | 9,109 | 8,404 | 10,706 | 11,887 | 16,695 |
| Farm Springs | Idaho | | 39 | 4,771 | 6,959 | 12,070 |
| Metaline | Washington | 1,926 | | 4,389 | 4,095 | 11,402 |
| Willow Creek | New Mexico | 16,847 | 13,372 | 9,667 | 10,882 | 11,291 |
| Hoche | Nevada | 11,196 | 12,183 | 12,047 | 12,472 | 8,414 |
| Smelter | Montana | 6,732 | 11,078 | 7,986 | 10,330 | 6,063 |
| Park City region | Utah | 9,693 | 9,659 | 13,579 | 19,342 | 5,678 |
| San Juan Mountains | Colorado | 125 | 153 | 140 | 2,092 | 4,308 |
| Bro Blanco | Arizona | 900 | 3,270 | 3,065 | 2,700 | 3,265 |
| Upper Mississippi Valley | Iowa, northern Illinois, Wisconsin. | 9,807 | 8,923 | 8,126 | 6,938 | 2,073 |
| Bush Valley | Utah | 859 | 981 | 1,366 | 2,205 | 1,955 |
| Ophir | do | 920 | 2,167 | 3,563 | 4,023 | 1,893 |
| Vallapai | Arizona | 5 | 67 | 524 | 1,714 | 1,660 |
| Summit Valley (Butte) | Montana | 21,165 | 37,646 | 34,940 | 22,033 | 942 |
| Tintic | Utah | 9 | 15 | 177 | 1,259 | 921 |
| Cataract | Montana | 212 | 1,029 | 1,354 | 1,043 | 605 |
| Flint Creek | do | 2,216 | 4,746 | 4,307 | 4,641 | 426 |
| Leadville | Colorado | 515 | 924 | 871 | 1,676 | 97 |
| Tybo | Nevada | (1) | (1) | (1) | 1,417 | |

[1] Bureau of Mines not at liberty to publish figures.

## STOCKS

Total stocks of slab zinc were 97 percent higher at the end than at the beginning of 1938, and year-end inventories on December 31, 1938, were the highest since 1930. Metal on hand at primary reduction plants increased 99 percent, while that at secondary distilling plants decreased 3 percent. Total stocks at the end of 1938 included 75,864 tons of the higher grades of zinc (A and B) and 83,562 tons of the lower grades (C, D, and E) compared with 36,996 and 44,117 tons, respectively, at the end of 1937.

According to the American Zinc Institute zinc stocks reached a peak at the end of June 1938 which was greater than the depression high established near the close of 1930. In the succeeding 5 months, however, shipments to consumers improved. Inventories declined steadily but in December rose substantially as demand fell and production increased.

*Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1934–38, in short tons*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| At primary reduction plants | 124,783 | 90,539 | 55,500 | 79,144 | 157,511 |
| At secondary distilling plants | 2,685 | 1,151 | 626 | 1,969 | 1,915 |
| | 127,468 | 91,690 | 56,126 | 81,113 | 159,426 |

Stocks of zinc ore in the Tri-State district showed a net decline for 1938. On January 1 about 15,000 tons of concentrates (sold and unsold) were on hand with an estimated recoverable zinc content of 8,000 tons. In the spring months demand for ore was sharply cur-

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tailed as stocks of metal at smelters mounted rapidly. By July 2 ore on hand reached a peak for the year of 27,000 tons, equivalent to about 14,000 tons of metal, but in the remaining 6 months ore shipments were considerably higher, and at the close of the year stocks were only 8,400 tons of ore, equivalent to 4,400 tons of metal.

O. W. Roskill, of London, in his review of the European and world zinc situation in 1938 at the annual meeting of the American Zinc Institute, Inc., at St. Louis in April 1939, estimated producers' stocks of metallic zinc outside the United States at 195,000 to 210,000 metric tons at the beginning of 1938 and 270,000 to 280,000 tons at the end. On this basis world stocks may be estimated to have increased from a maximum of about 310,000 short tons on January 1 to a maximum of 470,000 tons on December 31, 1938. The Consolidated Mining & Smelting Co. of Canada, Ltd., in its annual report for 1938, estimated world stocks at 300,000 short tons at the end of 1937 and 425,000 tons at the end of 1938. In addition large stocks of concentrates are held by European smelters and various mining companies throughout the world.

## DOMESTIC CONSUMPTION

*New supply.*—The supply of new zinc available for consumption in 1938 decreased 34 percent from 1937. Declines of 41, 24, and 48 percent, respectively, were recorded for copper, lead, and pig iron. Compared with 1925–29 averages, apparent consumption of zinc in 1938 dropped only 32 percent, whereas that of copper, lead, and pig iron decreased 48, 51, and 52 percent, respectively.

*Primary slab zinc available for consumption in the United States, 1934–38, in short tons*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Supply: | | | | | |
| Stock at smelters Jan. 1 | 110,487 | 124,783 | 90,539 | 55,500 | 79,144 |
| Production | 363,590 | 420,634 | 492,132 | 556,904 | 446,341 |
| Imports | 1,725 | 4,444 | 11,660 | 37,208 | 7,230 |
| Total available | 475,802 | 549,861 | 594,331 | 649,612 | 532,715 |
| Withdrawn: | | | | | |
| Exports | 5,105 | 1,617 | 37 | 249 | [1] 200 |
| Stock at smelters Dec. 31 | 124,783 | 90,539 | 55,500 | 79,144 | 157,511 |
| Total withdrawn | 129,888 | 92,156 | 55,537 | 79,393 | 157,711 |
| Available for consumption | 345,914 | 457,705 | 538,794 | 570,219 | 375,004 |

[1] Not separately recorded; estimated.

*Industrial use of slab zinc.*—In addition to the new supply noted in the preceding table, a large tonnage of secondary zinc is available each year for industrial use. The American Bureau of Metal Statistics estimates the total industrial use of primary and secondary zinc during the past 5 years as follows:

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*Estimated industrial use of zinc in the United States, 1934–38, in short tons* [1]

| Purpose | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| alvanizing: | | | | | |
| Sheets | 83,300 | 110,000 | 132,000 | 135,000 | 108,500 |
| Tubes | 22,000 | 25,000 | 36,000 | 37,000 | 29,300 |
| Wire | 20,000 | 25,000 | 30,000 | 33,000 | 23,600 |
| Wire cloth | 4,000 | 5,000 | 6,000 | 7,000 | 5,600 |
| Shapes [2] | 22,700 | 30,000 | 38,000 | 40,000 | 31,000 |
| | 152,000 | 195,000 | 242,000 | 252,000 | 198,000 |
| rass making | 98,000 | 124,000 | 165,000 | 169,000 | 102,000 |
| olled zinc | 40,900 | 56,500 | 55,000 | 58,000 | 46,000 |
| ie castings | 32,000 | 55,500 | 72,000 | 88,000 | 48,000 |
| ther uses [3] | 37,000 | 42,000 | 48,000 | 39,000 | 27,000 |
| | 359,900 | 473,000 | 582,000 | 606,000 | 421,000 |

[1] Year Book, American Bureau of Metal Statistics, 1938.
[2] Includes pole-line hardware, hollow ware, chains, and all articles not elsewhere mentioned.
[3] Includes slab zinc used for manufacture of French oxide, zinc for wet batteries, slush castings, the delverization of lead, and sundries.

The industrial use of zinc in 1938 was 31 percent lower than in 1937 nd equivalent to only 66 percent of the record established in 1929. \ll four major uses of zinc decreased in 1938; die casting 45 percent, rass making 40 percent, and galvanizing and rolled zinc 21 percent ach. Galvanizing took 47 percent of the total tonnage used in 1938 ompared with 42 percent in 1937. The totals for this item include inc used in electrogalvanizing and sheridizing. The former decreased rom 5,443 tons in 1937 to 3,978 in 1938 and the latter from 701 to 264 ons.

Zinc used in rolled products in 1938 (1937 figures in parentheses) ncluded 15,300 tons (18,500) in battery cans, 15,000 (17,000) in glass-ar tops, 2,000 (6,000) in automobile manufacture, 4,000 (4,750) in photoengraving sheet, 830 (1,200) in boiler plate, 270 (625) in brake ining, and 300 (400) in electric refrigerators. The remaining ton-nages were employed for various other uses or exported.

The principal item included in "Other uses" is the slab zinc used n the manufacture of French-process zinc oxide which amounted to bout 16,000 tons in 1938 compared with about 24,000 tons in 1937.

## PRICES

The downward trend in prices that was evident in the last quarter of 1937 continued the first half of 1938. From 5.00 cents at the beginning of the year, the St. Louis quotation for prime western metal gradually declined to 4.00 cents early in April as consumer interest waned and stocks mounted. Following announcement of the Administration's spending program to revive business there was a brief flurry upward, but by May 10 the price had settled again to 4.00 cents, the low for the year, where it remained until the latter part of June. At this time buying improved, and by July 1 the quotation had risen to 4.75 cents. Despite reductions in producers' stocks in July and August no further change occurred until the middle of September, when quotations again began moving upward. The high for the year,

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5.05 cents, was established on October 13 and maintained through November 18, when the price was reduced to 4.75 cents over the week-end following the announcement of the 0.35 cent per pound tariff cut as a result of the Canadian Trade Agreement. Although the reduced tariff was not effective until January 1, 1939, the cut in price at this time, according to trade reports, was a protective measure to discourage domestic consumers from contracting for forward metal from foreign producers. A further reduction to 4.50 cents took place on November 29, and this price level was held throughout December. The average for the year, 4.61 cents, was 29 percent below the average for 1937.

In London the decline in prices was more pronounced than in domestic markets, the average for 1938 having decreased 38 percent from that for 1937. The differential between New York and London increased from 1.49 cents per pound in April to 2.28 cents in November. At the close of the year the differential was 1.98 cents. The average differential for 1938 was 1.94 cents compared with 1.96 in 1937.

The trends in the New York and London prices during the last half of November are of interest in view of the sudden announcement on November 18 of the impending reduction in the United States import duty. From November 15 to 18 the differential rose from 2.42 to 2.46 cents, but after the sharp reduction in domestic prices on November 21 it fell to 2.19 cents. The following day the London quotation dropped 6 points bringing the differential back to 2.25 cents. On November 23 the foreign price recovered 5 points to 2.20 cents below the New York price. It then moved to lower levels and on November 28 was 2.29 cents under the New York quotation. Following the 0.25-cent cut in domestic prices on November 29, the differential declined to 2.05 cents and then to 1.98 cents on November 30, as London prices recorded a 0.07-cent advance.

*Price of zinc and zinc concentrates, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Average price of common zinc at— | | | | | |
| St. Louis (spot)—cents per pound | 4.16 | 4.33 | 4.90 | 6.52 | 4.61 |
| New York—do | 4.51 | 4.70 | 5.28 | 6.87 | 4.99 |
| London—do | 3.07 | 3.08 | 3.31 | 4.91 | 3.05 |
| Excess New York over London—do | 1.44 | 1.62 | 1.97 | 1.96 | 1.94 |
| Joplin 60-percent zinc concentrates: | | | | | |
| Price per short ton—dollars | 27.14 | 28.81 | 31.95 | 39.87 | 27.83 |
| Price of zinc content—cents per pound | 2.26 | 2.40 | 2.66 | 3.32 | 2.32 |
| Smelter margin—do | 1.90 | 1.93 | 2.24 | 3.20 | 2.29 |
| Price indexes (1925–29 average=100): | | | | | |
| Zinc (New York) | 63 | 66 | 74 | 97 | 70 |
| Lead (New York) | 52 | 54 | 63 | 80 | 63 |
| Copper (New York) | 58 | 59 | 65 | 90 | 68 |
| Nonferrous metals [1] | 68 | 69 | 72 | 91 | 74 |
| All commodities [1] | 76 | 81 | 82 | 88 | 80 |

[1] Based on price indexes of the U. S. Department of Labor.

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*Average monthly quoted prices of common zinc (prompt delivery or spot) at St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1937–38* [1]

| Month | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | 60-percent zinc concentrates in the Joplin region (dollars per ton) | Metallic zinc (cents per pound) | | 60-percent zinc concentrates in the Joplin region (dollars per ton) | Metallic zinc (cents per pound) | |
| | | St. Louis | London | | St. Louis | London |
| January | 35.65 | 5.86 | 4.63 | 29.13 | 5.00 | 3.34 |
| February | 39.99 | 6.43 | 5.49 | 28.17 | 4.82 | 3.23 |
| March | 44.81 | 7.38 | 7.24 | 27.28 | 4.41 | 3.20 |
| April | 44.72 | 6.99 | 5.75 | 26.04 | 4.15 | 3.05 |
| May | 41.16 | 6.75 | 5.09 | 25.43 | 4.04 | 2.81 |
| June | 41.16 | 6.75 | 4.72 | 25.43 | 4.14 | 2.85 |
| July | 41.39 | 6.93 | 5.00 | 27.75 | 4.75 | 3.11 |
| August | 42.76 | 7.20 | 5.37 | 27.75 | 4.75 | 2.93 |
| September | 43.47 | 7.18 | 4.73 | 27.75 | 4.85 | 3.01 |
| October | 38.75 | 6.09 | 3.92 | 29.47 | 5.01 | 3.21 |
| November | 33.76 | 5.63 | 3.52 | 30.56 | 4.91 | 3.02 |
| December | 29.40 | 5.01 | 3.41 | 27.16 | 4.50 | 2.86 |
| Average for year | 39.87 | 6.52 | 4.91 | 27.83 | 4.61 | 3.05 |

[1] All quotations from Metal Statistics, 1939. Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

*Average price of zinc received by producers, 1934–38, by grades, in cents per pound*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Grade A (high grade) [1] | 4.50 | 4.55 | 5.15 | 6.65 | 5.03 |
| Grade B (intermediate) | | | | | |
| Grades C and D (select and brass special) [1] | 4.10 | 4.31 | 4.91 | 6.47 | 4.73 |
| Grade E (prime western) | 4.15 | 4.32 | 4.89 | 6.44 | 4.71 |
| All grades | 4.3 | 4.4 | 5.0 | 6.5 | 4.8 |
| Prime western; spot quotation at St. Louis | 4.2 | 4.3 | 4.9 | 6.5 | 4.6 |

[1] American Metal Market quotes average prices of high grade and brass special as follows: High grade (f. o. b. New York), 1934, 5.24 cents; 1935, 5.33 cents; 1936, 5.90 cents; 1937, 7.76 cents; 1938, 5.74 cents; brass special (f. o. b. East St. Louis), 1934, 4.23 cents; 1935, 4.41 cents; 1936, 4.98 cents; 1937, 6.62 cents; 1938, 4.71 cents.

## ZINC-REDUCTION PLANTS

*Zinc smelters.*—At the close of 1938 there were 19 primary zinc-distillation plants in the United States—17 active during the year and 2 idle. Except for 224 retorts added to existing blocks at the Bartlesville plant no new capacity was installed in 1938. The Van Buren plant, which had been idle since 1927 and was rehabilitated and put into operation during 1937, was active part of 1938, but was idle at the end of the year. Of the 17 active plants, 13 operated exclusively with horizontal retorts, 1 with both horizontal and vertical retorts, 2 with large vertical retorts exclusively, and 1 with electrothermic furnaces. At the active plants 69,180 horizontal retorts were available, and 33,949 were in use at the end of the year. In addition, 46 of the 52 installed vertical retorts were operating at the close of 1938.

Many primary smelters treat scrap as well as ore. Horizontal-retort plants at Beckemeyer and Sandoval, Ill., and large graphite-retort plants at Trenton, N. J., Philadelphia and Bristol, Pa., Wheeling, W. Va., and Tottenville, N. Y., operate exclusively on scrap.

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The Torrance (Calif.) plant of Pacific Smelting Co., Ltd., contains small clay retorts as well as large graphite retorts for treating secondary materials. W. J. Bullock is operating a new large graphite-retort plant at Fairfield, Ala.

*Electrolytic plants.*—The Evans-Wallower Zinc Co. plant at East St. Louis continued idle in 1938 despite rumors that it was to be reopened. The Anaconda and Great Falls (Mont.) plants of the Anaconda Copper Mining Co. operated at greatly reduced capacity in 1938. Both plants were closed during part of January and February. The Kellogg plant of the Sullivan Mining Co. completed a 50-percent increase in plant capacity in 1938. Two of the three units were operated during the first quarter of 1938, but only one unit was used the remainder of the year. At the three active plants 1,460 cells out of a total of 2,192 were in use at the end of 1938.

## TECHNOLOGY

Despite market conditions in 1938, which hardly warranted expenditures for improving plants and technique, there were several interesting developments in technology.

*Mining.*—The practice of replacing ore pillars with concrete now being developed in the Southeast Missouri lead district is being considered in the Tri-State area, where pillars constitute 7 to 10 percent of the mineralized areas. The D. C. & E. mine at Oronogo, Mo., has been completely mechanized on an experimental basis, using scrapers, conveyers, skips, and other modern equipment; mining costs are reported to be half the average of the district. Development work at the Grasselli mine, New Market, Tenn., which began production in 1937, consisted largely of preparation for mill-hole and slusher hoist operations.

*Milling.*—The heavy-density cones at Mascot, Tenn., continued to operate satisfactorily throughout 1938. Additional equipment, installed to increase capacity, resulted in decreased milling costs and higher recoveries. Experimentation with a similar process continued at the Central mill of the Eagle-Picher Mining & Smelting Co., Picher, Okla. In the western lead-zinc areas Engelmann [2] reports that minerec "A" is used in 80 percent of the plants where it has partly or completely replaced xanthate in the lead circuits. Sodium Aerofloat is used extensively as a zinc promoter. He also states that the Fagergren flotation machine is finding favor with lead-zinc operators.

*Reduction.*—Aside from the 224 retorts added to existing furnaces at Bartlesville, no new domestic smelting capacity was built in 1938. Sinn [3] reports that outputs per retorts and recoveries have been improved at domestic horizontal-retort smelters. In European plants larger retorts are being used; daily production of more than 70 pounds of zinc per retort is common practice at 90 percent or better recovery, and 90-pound outputs are being considered. Because of the superior quality of European clays, which permits higher temperatures, it is possible to use larger retorts in Europe than in the

[2] Engelmann, E. W., Ore Concentration and Gold Milling: Min. and Met., vol. 20, No. 385, January 1939, pp. 13–14.
[3] Sinn, Francis P., Metallurgy of Zinc: Min. and Met., vol. 20, No. 385, January 1939, pp. 18–19.

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United States. Prolongs also are used in European plants, and American producers probably lose at least 5 percent of their zinc by not following European practice in this respect. General progress in process improvement was reported by the large vertical-retort smelters and the electrothermic smelting plant at Josephtown, Pa. Two additional Waelz kilns were constructed, making a total of eight in use at retort smelters and zinc oxide plants in the United States.

The 50-percent addition to the electrolytic zinc plant in Idaho was put into production in 1938, but this plant as well as those at Anaconda and Great Falls, Mont., operated at only partial capacity throughout the year. Emphasis is being placed on increasing the production of 99.99+ percent metal. Electrogalvanizing of wire is progressing, and production of sheets by the same process is being considered. New electrolytic zinc plants are planned for Yugoslavia, Rumania, and Peru, and the feasibility of another in Quebec for treating Noranda and other ores is being investigated.[4]

## FOREIGN TRADE[5]

*Imports.*—The following tables give zinc imports into the United States, 1934–38, inclusive, and a record of bonded-warehouse inventories.

*Zinc ores (zinc content) imported into the United States, 1934–38, in short tons* [1]

| Year | Canada | Mexico | Other countries | Total | Year | Canada | Mexico | Other countries | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1934 | (2) | 14,277 | (2) | 14,277 | 1937 | 84 | 338 | [3] 8,390 | 8,812 |
| 1935 | | 10,520 | | 10,520 | 1938 | | 7,253 | [3] 11,330 | 18,583 |
| 1936 | | 172 | | 172 | | | | | |

[1] Data include ore imported for immediate consumption plus material entering the country under bond.
[2] Less than 1 ton.
[3] Includes 8,373 tons imported from Peru in 1937; all from Peru in 1938.

*Zinc* [1] *remaining in warehouse in the United States, December 31, 1934–38*

| | Pounds | | Pounds |
|---|---|---|---|
| 1934 | 14,354,435 | 1937 | 24,904,405 |
| 1935 | 13,840,586 | 1938 | 51,058,378 |
| 1936 | 10,690,832 | | |

[1] Includes zinc ore (zinc content), zinc blocks, pigs, old, and sheets.

Imports of zinc ore in 1938 increased 111 percent over 1937 owing to large increases in shipments from Mexico and Peru. Those of slab zinc decreased 81 percent from 1937, the peak year. Of the 7,230 tons received, Mexico furnished 3,346, Canada 2,332, Poland and Danzig 1,210, Belgium 286, and other British South Africa 56.

[4] Shelton, S. M., and Duncan, W. E., Zinc Metallurgy Is Far from Static: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 81–82.
[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Zinc imported for consumption in the United States, 1934–38*

| Year | Blocks, pigs, or slabs | | Sheets | | Old, dross, and skimmings [1] | | Zinc dust | | Value of manufactures | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | | |
| 1934 | 1,725 | $112,923 | 55 | $6,978 | | | 18 | $1,395 | $8,523 | $129,819 |
| 1935 | 4,444 | 270,350 | 112 | 9,423 | 29 | $979 | 40 | 2,486 | 1,149 | 284,387 |
| 1936 | 11,660 | 770,496 | 242 | 23,077 | 16 | 769 | 57 | 3,647 | 540 | 798,529 |
| 1937 | 37,208 | 3,852,884 | 231 | 30,398 | 678 | 70,460 | 69 | 6,169 | 828 | 3,960,739 |
| 1938 | 7,230 | 480,169 | 226 | 25,989 | 96 | 8,944 | 64 | 5,074 | 463 | 520,639 |

[1] Includes dross and skimmings: 29 tons valued at $974 in 1935; 15 tons valued at $721 in 1936; and 560 tons valued at $59,635 in 1937. No imports reported in 1938.

*Exports.*—The total value of the 1938 exports of zinc ore and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) was approximately $1,271,000, a decrease of 18 percent from 1937. Exports of plates, sheets, pigs, and slabs decreased 5 percent, while those of zinc dust increased 5 percent in quantity but decreased 15 percent in value. Besides the items shown in the accompanying tables, considerable zinc is exported each year in brass, pigments, chemicals, and galvanized iron and steel. The American Bureau of Metal Statistics estimates that 13,300 tons of zinc were exported in galvanized products in 1938 compared with 13,900 tons in 1937. Export data on zinc pigments and chemicals are given in the chapter on Lead and Zinc Pigments and Zinc Salts in this volume. Much of the zinc used in the manufacture of these products is of foreign origin, and when it is exported a draw-back is paid amounting to 99 percent of the import duty. In 1938 draw-back was paid on 11,550 tons of zinc, of which 7,989 tons had been imported as slabs and 3,561 tons as ore. Totals for previous years were: 1937, 9,253; 1936, 8,909; 1935, 7,297; and 1934, 4,139.

*Zinc ore and manufactures of zinc exported from the United States, 1934–38*

| Year | Zinc ore, concentrates, and dross (zinc content) | | Pigs or slabs | | Plates and sheets | | Zinc dust | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 3,621 | $157,419 | 5,105 | $284,023 | 3,462 | $569,208 | 1,489 | $223,868 |
| 1935 | 461 | 10,818 | 1,617 | 83,925 | 4,813 | 755,033 | 1,613 | 238,158 |
| 1936 | 245 | 5,902 | 37 | 4,962 | 4,483 | 723,142 | 1,793 | 273,813 |
| 1937 | 314 | 10,145 | 249 | 25,706 | 5,813 | 1,103,533 | 2,145 | 418,376 |
| 1938 | 135 | 6,404 | (1) | (1) | [1] 5,736 | [1] 908,381 | 2,253 | 355,856 |

[1] Pigs and slabs not shown separately; included with plates and sheets.

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*Slab and sheet zinc exported from the United States, 1935–38, by destinations, in short tons*

| Destination | Slabs, blocks, or pigs | | | | Sheets, strips, etc. | | | |
|---|---|---|---|---|---|---|---|---|
| | 1935 | 1936 | 1937 | 1938 | 1935 | 1936 | 1937 | 1938 |
| Countries: | | | | | | | | |
| Canada | 5 | 5 | 1 | (1) | 2,159 | 1,999 | 2,251 | 2,317 |
| Chile | 7 | 7 | 65 | (1) | 2 | 6 | 1 | 9 |
| France | ------ | ------ | 125 | (1) | 12 | 3 | (2) | ------ |
| Germany | 72 | ------ | ------ | (1) | 8 | 4 | 2 | 13 |
| India, British | 1,121 | ------ | ------ | (1) | 2 | 3 | 90 | 110 |
| Japan | ------ | 1 | ------ | (1) | 191 | 199 | 194 | 232 |
| United Kingdom | 1 | ------ | 23 | (1) | 1,367 | 1,048 | 849 | 775 |
| Others | 411 | 24 | 35 | (1) | 1,072 | 1,221 | 2,426 | 2,280 |
| Total | 1,617 | 37 | 249 | (1) | 4,813 | 4,483 | 5,813 | 5,736 |
| Continents: | | | | | | | | |
| North America | 43 | 19 | 10 | (1) | 2,379 | 2,164 | 2,413 | 2,527 |
| South America | 21 | 10 | 72 | (1) | 285 | 244 | 409 | 643 |
| Europe | 425 | ------ | 148 | (1) | 1,587 | 1,151 | 922 | 914 |
| Asia | 1,128 | 8 | 19 | (1) | 382 | 678 | 1,010 | 673 |
| Africa | ------ | ------ | ------ | (1) | 15 | 1 | 82 | 107 |
| Oceania | (1) | ------ | ------ | (1) | 165 | 245 | 977 | 872 |

[1] Slabs, blocks, or pigs not shown separately; included with sheets, strips, etc.
[2] Less than 1 ton.

## WORLD ASPECTS OF ZINC INDUSTRY

*Cartel activities.*—Efforts to reconstitute the International Zinc Cartel which collapsed in 1934 were stimulated in 1938 by declining prices and mounting stocks of ore and metal but without success. Among the unsurmountable obstacles is the nationalistic policy of Germany and Italy, who refuse to consider any curtailment of output within their confines, despite its uneconomic character. The agitation for a large increase in the British tariff on zinc, designed to exclude non-British zinc from the United Kingdom, was another barrier. Still another obstacle, pointed out by Roskill,[6] is the apathy of custom smelters and ore producers toward cutailment of production. The custom smelter is more interested in treating a large volume of ore on a per-ton basis than in maintaining prices. Although this is a short-sighted policy and in the long run is detrimental to the best interests of the custom smelter, it undoubtedly prevails at present because the future of international relations is so uncertain. The producer's attitude is due to the byproduct nature of zinc, and mine operators are disposed to maintain lead and silver production schedules without regard to the resulting overproduction of zinc. The present outlook for international cooperation in the slab-zinc industry certainly cannot be considered hopeful.

In February 1938 an International Zinc Sheet Cartel was formed and eventually included producers in 10 countries—the United Kingdom, Belgium, the Netherlands, Germany, France, Spain, Hungary, Poland, Yugoslavia, and Czechoslovakia. Italy was not included, but Belgian control of Italian rolling mills was expected to prevent any disturbing influence from this source.

*World production.*—World production of zinc (smelter basis) decreased 4 percent from the record established in 1937. This decline

[6] Roskill, O. W., Lead, Zinc, and Cadmium in 1938: Min. Jour., London, vol. 204, No. 5402, Mar. 4, 1939, pp. 169–171.

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was due entirely to the 20-percent drop in United States production, as the total output elsewhere increased 4 percent to a new all-time peak. Compared with 1929, production in the United States in 1938 decreased 29 percent, whereas that of the rest of the world increased 30 percent. The United States proportion of the world total was 39 percent in 1929, 31 percent in 1937, and only 26 percent in 1938. There were also notable declines in output in Belgium, Italy, Northern Rhodesia, and the United Kingdom and substantial increases in Canada, Germany, Japan, Norway, and the U. S. S. R. in 1938.

*World smelter production of zinc, 1934–38, in metric tons, by countries where smelted*

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia | 55,506 | 68,752 | 71,641 | 70,869 | 70,941 |
| Belgium | 174,900 | 181,740 | 195,320 | 217,750 | 209,983 |
| Canada | 122,394 | 135,645 | 137,078 | 143,826 | 155,973 |
| Czechoslovakia | 7,616 | 9,648 | 7,670 | 7,336 | 8,876 |
| France | 47,248 | 47,443 | 51,694 | 60,427 | 60,560 |
| Germany [1] | 71,196 | 123,198 | 133,427 | 163,814 | 192,000 |
| Indochina | 4,240 | 3,837 | 4,112 | 4,204 | 4,447 |
| Italy | 24,864 | 27,579 | 27,025 | 37,982 | 34,065 |
| Japan | 32,145 | 34,191 | 39,066 | 45,500 | [2] 50,000 |
| Mexico | 29,148 | 32,327 | 31,913 | 36,587 | 35,881 |
| Netherlands | 19,911 | 13,747 | 15,428 | 24,645 | 25,300 |
| Northern Rhodesia | 19,854 | 21,012 | 21,063 | 14,256 | 10,379 |
| Norway | 45,027 | 45,019 | 45,028 | 41,276 | 46,500 |
| Poland | 92,921 | 84,606 | 92,580 | 107,174 | 108,071 |
| Spain | 8,184 | 7,648 | 7,803 | 5,279 | 7,672 |
| U. S. S. R. | 27,084 | 47,910 | 66,000 | [2] 65,000 | [2] 70,000 |
| United Kingdom [1] | 52,022 | 61,433 | 61,768 | 63,138 | 56,190 |
| United States | 329,842 | 381,591 | 446,452 | 505,212 | 404,912 |
| Yugoslavia | 4,037 | 3,356 | 3,599 | 5,012 | 5,956 |
| | 1,168,000 | 1,331,000 | 1,459,000 | 1,619,000 | [2] 1,558,000 |

[1] Some secondary material included.

[2] Approximate production.

*World consumption.*—World consumption of slab zinc, according to the American Bureau of Metal Statistics, amounted to 1,487,000 metric tons, 9 percent less than in 1937. Consumption in the United States decreased 33 percent, whereas that of the rest of the world increased 3 percent and established a new peak. The international armament race continues to play an important part in maintaining consumption abroad, and undoubtedly some nations are accumulating war stockpiles of zinc. Zinc consumption in the United States in 1938 declined 31 percent compared with 1929, but that elsewhere rose 20 percent.

The United States again ranked first in zinc consumption, taking 25 percent of the total. Germany ranked second with 18 percent, and the United Kingdom third with 14 percent. Belgium used 7 percent, France and Japan each 6, and U. S. S. R. 5 percent. Of the foregoing countries, Germany, U. S. S. R., Japan, and Belgium used 11, 11, 6, and 2 percent more zinc than in 1937, respectively, whereas the United Kingdom and France used 9 and 3 percent less, respectively.

## REVIEW BY COUNTRIES

*Australia.*—The electrolytic zinc plant at Risdon continued capacity operation in 1938. Approximately one-third of the product is obtained from Tasmanian ores and two-thirds from Broken Hill ores.

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In the Broken Hill district interest centered in the development of the New Broken Hill mine, which is expected to begin production in 1940, and exhaustion of the Broken Hill Proprietary mine, which closed early in February 1939. The latter began operations in 1885 and has produced 12,300,000 long tons of ore yielding 1,445,000 tons of lead, 189,457,000 ounces of silver, and 603,000 tons of zinc. At North Broken Hill the new concentrator, capacity 50,000 tons per month, was placed in operation April 11, 1939. The Zinc Corporation continued the enlargement of its mill and surface equipment in anticipation of treating the ore from the adjoining New Broken Hill mine; a new shaft is being sunk that will serve both mines. Crude-ore production of the district was approximately 1,545,000 tons, an increase of 77,000 tons over 1937.

Mt. Isa made a profit of £19,742 in the year ended June 30, 1938, compared with £70,309 in the previous year. In the last fiscal year 609,377 tons of ore were produced, of which 594,752 tons were milling ore containing 9.8 percent zinc, 8.9 percent lead, and 7.3 ounces of silver per ton. Ore reserves were estimated at 9,354,500 tons. Milling methods and costs have been described by Kruttschnitt [7] and others.

The Lake George mine began production in January 1939 when the first 500-ton-per-day unit of the concentrator was started. Another 500-ton unit is contemplated.

Total mine production of zinc in Australia was estimated at 178,500 tons in 1938. Exports of metallic zinc totaled 38,000 tons compared with 39,500 tons in 1937. Nearly 194,000 tons of concentrates were shipped abroad in 1938 as against 187,000 tons in 1937.

*Belgium.*—Imports of zinc ore totaled 537,000 metric tons in 1938, a decline of 13 percent from 1937. Mexico supplied 27 percent of the total. Other important sources were British India, Sweden, Yugoslavia, Canada, Newfoundland, Australia, Italy, and Spain. Receipts from Spain and Italy increased, but those from the other countries decreased. Exports of slab zinc declined from 151,000 to 130,000 tons; shipments to the United Kingdom decreased, while those to Germany increased. Exports of zinc sheets and wire dropped from 47,000 to 38,000 tons. Imports of slab zinc were reduced from 24,000 to 14,000 tons. Vieille Montagne produced nearly 110,000 tons of zinc at its various plants in Belgium and elsewhere, 7 percent less than in 1937. The entire reduction was in retort metal, as the output of electrolytic zinc was maintained at full capacity—37,000 tons.

*Burma.*—The Burma Corporation, Ltd., produced 60,744 long tons of zinc concentrates averaging over 58 percent zinc in 1938, compared with 73,552 tons averaging slightly under 58 percent in 1937. The decline in output was due to the reduced zinc content of the ore mined in 1938. The concentrates are shipped chiefly to Belgium. Imports of slab zinc into British India, used largely in galvanizing, declined from 24,000 to 21,000 tons.

*Canada.*—Seventy-eight percent of Canada's production of metallic zinc in 1938 was made at Trail and 22 percent at Flin Flon. Both plants increased their output over 1937. Construction of a third

[7] Kruttschnitt, J., Jacobsen, L. K., and Gross, K. B., Milling Methods and Costs of the Mt. Isa Mines, Ltd., Mount Isa, Queensland, Australia: Bureau of Mines Inf. Circ. 7073, 1939, 33 pp.



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electrolytic zinc plant has been mentioned as a possibility by the Minister of Mines for Quebec. The plant would provide a market for zinc concentrates from the Waite Amulet, Normetal, Noranda, and Quebec Manitou mines. Shawinigan Water & Power Co. is said to be interested in the project which would be financed by American capital. Reserves of copper-gold-silver-zinc ore at the Waite Amulet property were increased extensively by new discoveries in 1938. Exports of zinc ore from Canada declined from 33,000 to 23,000 short tons, the bulk of which was consigned to Belgium. Exports of slab zinc in 1938 totaled 132,000 tons compared with 134,000 in 1937. The United Kingdom took nearly 100,000 tons and Japan 15,000 tons in 1938; both countries increased their purchases.

*France.*—Although the smelter output of zinc increased only slightly, imports of zinc ore increased 22 percent. Of the 192,000 metric tons received in 1938, 54,000 came from Mexico, 32,000 from other North America, 23,000 from Turkey, 16,000 from Yugoslavia, 15,000 from Sweden, 12,000 from Italy, and 40,000 from other countries. Exports of zinc ore declined from 55,000 to 38,000 tons; these ores move largely to Norway after removal of the sulfur. France also imports large quantities of slab zinc—32,000 tons in both 1937 and 1938. There is a small subsidized ore production in France and the French colonies.

*Germany.*—Much of the 17-percent increase in Germany's smelter output in 1938 resulted from enlargement of the Magdeburg electrolytic zinc plant, the annual capacity of which was increased from 40,000 to 60,000 metric tons. Some of the older retort furnaces have been rehabilitated to increase their output. Construction of a second unit of 8 continuously operated vertical retorts at Oker will be completed in 1939, and construction of 16 additional retorts has begun. Two old smelters were acquired with the annexation of Sudeten Czechoslovakia, the production of which has amounted to 7 or 8 thousand tons annually in recent years, largely from imported ore, however. Mine production in Germany made some progress in 1938, and new developments in treating the zinciferous pyrite and cinder at Meggen probably will increase domestic output considerably. Imports of slab zinc increased from 71,000 to 75,000 tons in 1938 and of zinc ore from 146,000 to 185,000 tons. Exports of zinc ore also increased, from 45,000 to 47,000 tons, and those of crude zinc rose from 100 to 6,900 tons.

*Indochina.*—In view of recent Japanese aggression in southeastern China the zinc production of Indochina is of interest. In 1938, 4,447 metric tons of metallic zinc were produced compared with 4,204 tons in 1937. A smelter at Quang Yen, Tonkin, treats 45-percent concentrates from the mines at Chodien. Virtually all the metal is exported to France. No ore was exported in 1938.

*Italy.*—Apparently Italy's zinc requirements declined in 1938 as there was a 10-percent reduction in smelter output. Production of zinc ores, however, increased from 182,000 to 202,000 metric tons as a result of the pressure to increase lead production. Exports were well maintained at 74,000 tons, of which a large part went to Belgium, Poland, and France. Italy's foreign trade in metallic zinc is no longer important. The lead-zinc deposits of the Arbus area, Sardinia, have

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been described by Wright.[8] A new plant for recovering secondary zinc is being erected in Genoa.

*Japan.*—Publication of official statistics was discontinued in 1937, so details for 1938 are not available. Showa K. K. apparently has decided to build the new electrolytic plant at its Hibi works in Okayama Prefecture. The plant will have a monthly capacity of 500 tons of metal. It is also stated that the company is to mine and smelt 6,000 tons of zinc annually in Chosen. Zinc was reported to be scarce during 1938, and on August 1 official control of supplies was established. Restrictions were placed on the use of zinc for foil or tubes and in alloys for export trade.

*Mexico.*—Mine production totaled 172,000 metric tons in 1938 compared with 155,000 tons in 1937. Smelter output amounted to only 36,000 tons in 1938, leaving approximately 130,000 tons (260,000 tons of 50-percent concentrates) available for export after allowing for smelter losses on ores treated in Mexico. Mexican export figures do not report shipments of zinc ore or concentrates separately. However, reported receipts of Mexican ore in 1938 were: Belgium 147,000 tons, France 54,000, the United States approximately 15,000, Germany 12,000, the Netherlands 6,000, and Poland 4,000. Mexican trade returns for 1938 report shipments of 5,200 tons of zinc to Japan and 900 tons to Manchuria. The Rosita smelter experienced labor troubles the latter part of the year.

*Newfoundland.*—Production of zinc concentrates totaled 122,000 short tons in 1938 compared with 120,000 tons in 1937. The 1938 product contained 63,000 tons of zinc and 470,000 ounces of silver. Lead and copper concentrates contained an additional 11,000 tons of zinc.

*Peru.*—The Cerro de Pasco Copper Corporation has been considering construction of an electrolytic zinc plant in Peru for several years. Apparently the project finally has been approved, as the president of the company stated at the stockholders' meeting in May 1938 that $3,500,000 to $4,500,000 was to be spent for this purpose. A pilot plant was under construction in January 1939. Peruvian exports of zinc concentrates declined from 29,000 metric tons in 1937 to 25,000 in 1938.

*Poland.*—Exports of slab zinc declined from 69,402 metric tons in 1937 to 58,123 in 1938 and imports of zinc ore from 116,000 to 104,000 tons. Mine production rose from 63,000 to 67,000 tons (recoverable content). Giesche Spolka Akcyjna increased its output of slab zinc from nearly 43,000 tons to nearly 51,000 but reported a loss of 998,027 zlotys for the year ending March 31, 1938.

*Spain.*—Production at the Reocin mine was reported to be approaching normal in May 1938, when the Arnao smelter was said to be producing at the rate of about 8,000 metric tons of zinc annually. French receipts of Spanish ore declined from 32,500 tons in 1937 to 1,200 in 1938, whereas German and Belgian importations increased materially.

*United Kingdom.*—The British Metal Corporation, Ltd., estimates consumption of zinc at 180,000 long tons in 1938, a decrease of 24,000 tons from 1937. Of the 1938 total, 63,000 tons were used for galvanizing (29,000 for sheet and 34,000 for other galvanizing), 52,000 tons

[8] Wright, Charles Will, The Lead-Zinc Deposits and Geology of the Arbus Area in Sardinia, Italy: Econ. Geol. vol. 34, No. 1, 1939, p. 82.

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for brass, 29,000 tons for oxide, 20,000 tons for rolled products, 12,000 tons for die casting, and 4,000 tons for miscellaneous uses. Approximately 30 percent of the slab zinc used was supplied by domestic smelters operating largely on imported ores and 70 percent by imported metal. Imports of ore totaled 158,000 tons in 1938, of which nearly 110,000 tons came from Australia and over 45,000 tons from Newfoundland; 151,000 tons of ore were imported in 1937. Imports of slab zinc fell from 177,000 to 165,000 tons. The larger part of the metal likewise is obtained from other British countries. Shipments from Belgium declined from 57,000 to 37,000 tons. Stocks of zinc in official warehouses were 20,200 tons at the beginning and 25,400 at the close of the year. Mine production increased only slightly and amounted to approximately 6,000 tons of recoverable zinc.

Agitation for increased tariff protection for the domestic smelting industry continued during 1938. The present import duty on non-British zinc is 12s. 6d. per ton or 10 percent ad valorem, whichever is less. Early in 1939 it was proposed to raise the import duty to 30s. with a corresponding rise in the premium on Empire zinc. Of the 17s. 6d. increase in premium on Empire zinc, 10s. would be paid to Imperial Smelting Corporation as a direct subsidy and 5s. would go into a rebate pool from which zinc manufacturers would be paid draw-back on exported goods. It was reported that consumers objected to this scheme.

*Yugoslavia.*—Trepca Mines, Ltd., treated 655,892 metric tons of ore from its own mines in the year ended September 30, 1938, compared with 638,729 tons in the previous year. Despite the larger tonnage of ore treated the quantity of zinc concentrates produced increased only from 69,863 to 70,120 tons. In addition 101,608 tons were milled for Kopaonik Mines, Ltd., from October 1, 1937, to June 10, 1938, at which time production at the Vojetin mine of the company was discontinued because of low prices. In August 1938, the properties of the Kopaonik, Zletovo, and Novo Brdo companies were absorbed by Trepca Mines, Ltd. An agreement has been made with the Government whereby Trepca will construct an electrolytic zinc plant at Sobac with an annual capacity of 10,000 tons of metal. In the fiscal year 1938 Trepca shipped 8,000 tons of concentrates to local smelters and exported 62,000 tons, chiefly to Belgium and France.

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# LEAD AND ZINC PIGMENTS AND ZINC SALTS

By H. M. MEYER AND A. W. MITCHELL

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The lead and zinc pigments industry was affected adversely by unsatisfactory conditions in the principal industries that consume pigments—manufacturers of paint, automobiles, pneumatic tires, and storage batteries. On the whole pigment consumption was at a low level in the early months of the year and improved with general industrial conditions in the third quarter. Despite declines in the final quarter most pigments were selling higher than their lowest levels of the year as 1938 ended.

*Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 (average) and 1934–38*

| | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Production (sales) of principal pigments: | | | | | | |
| White lead (dry and in oil) short tons | 154,483 | 78,734 | 96,831 | 118,407 | 98,213 | 98,983 |
| Litharge do | 84,845 | 68,733 | 79,930 | 86,246 | 83,902 | 68,711 |
| Red lead do | 41,362 | 26,743 | 28,776 | 34,896 | 33,931 | 30,183 |
| Zinc oxide do | 154,208 | 87,088 | 99,697 | 126,800 | 114,652 | 79,129 |
| Leaded zinc oxide do | 26,609 | 20,506 | 29,976 | 40,512 | 40,343 | 38,216 |
| Lithopone do | 177,745 | 145,565 | 159,486 | 158,319 | 154,771 | 125,746 |
| Value of products: | | | | | | |
| All lead pigments | $60,092,000 | $24,002,000 | $28,064,000 | $34,206,000 | $35,676,000 | $28,204,000 |
| All zinc pigments | 41,314,000 | 24,106,000 | 26,500,000 | 27,862,000 | 28,038,000 | 23,301,000 |
| Total | 101,406,000 | 48,108,000 | 54,564,000 | 62,068,000 | 63,714,000 | 51,505,000 |
| Value per ton received by producers: | | | | | | |
| White lead (dry) | 178 | 126 | 124 | 126 | 140 | 124 |
| Litharge | 176 | 103 | 104 | 116 | 143 | 122 |
| Red lead | 193 | 123 | 121 | 133 | 160 | 137 |
| Zinc oxide | 133 | 113 | 103 | 90 | 103 | 117 |
| Leaded zinc oxide | 124 | 98 | 93 | 87 | 104 | 107 |
| Lithopone | 98 | 84 | 84 | 82 | 78 | 79 |
| Foreign trade: | | | | | | |
| Lead pigments: | | | | | | |
| Value of exports | 1,346,000 | 404,000 | 512,000 | 546,000 | 586,000 | 510,000 |
| Value of imports | 30,000 | 4,000 | 2,000 | 12,000 | 17,000 | 10,000 |
| Zinc pigments: | | | | | | |
| Value of exports | 2,150,000 | 395,000 | 392,000 | 420,000 | 610,000 | 339,000 |
| Value of imports | 931,000 | 373,000 | 468,000 | 375,000 | 414,000 | 285,000 |
| Export balance | 2,535,000 | 422,000 | 434,000 | 579,000 | 765,000 | 554,000 |



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Apparently Japanese restrictions on imports of zinc metal and residues have seriously curtailed zinc oxide trade in that country. According to the Bureau of Foreign and Domestic Commerce[1] the annual production of zinc oxide in Japan was estimated at 30,000 tons, requiring about 35 percent of the total zinc imports into the country. The report also stated that most of the zinc oxide produced is consumed domestically, about 40 percent going to the paint and varnish trades and 30 percent to rubber manufacturers. A later report stated that the restrictions noted were forcing substitution of titanium pigments and lithopone for zinc oxide.

Two articles[2] published in 1938 may be of interest to the pigments industries.

Although zinc pigments fell 22 percent in total quantity compared with only 9 percent for lead pigments, they actually fared better than the latter, for they declined only 17 percent in total value compared with 21 percent. Of the principal pigments sold the average values received by producers ranged from 11 to 15 percent lower for lead pigments compared with gains in average values for zinc pigments of 1 to 14 percent. Zinc pigments made a better showing in relation to 1925–29 averages also, the total value of zinc pigments in 1938 being 56 percent of the average for 1925–29 compared with 47 percent for lead pigments. The continuing trend toward leaded grades of zinc oxide is shown in the decline of only 5 percent in pigments of this class from the high record tonnages for 1937 and 1936 compared with a decline of 31 percent from 1937 in lead-free zinc oxide. The quoted prices for lead pigments in general followed those for pig lead, receding to the low point of 1938 in midyear and rising in the third quarter. Zinc pigments were unresponsive to price changes for the metal. Prices for some were unchanged from quotations for 1937 and for others were established throughout the year at the best levels attained in 1937.

Titanium pigments again absorbed a larger share of the market for white pigments than in previous years.

## PRODUCTION

In this report sales are used as being more significant than production, for no account is taken of stocks on hand at the beginning and end of the year. The quantities consumed by the producers in manufacturing products at their own plants are included under sales. Production figures are used only in calculating the metal content of pigments and salts in the section of this report on Raw Materials Used in the Manufacture of Lead and Zinc Pigments and Zinc Salts.

The total value of lead and zinc pigments dropped from $63,714,000 in 1937 to $51,505,000 in 1938—only about one-half of the average annual total for 1925–29. The decline is explained by smaller total sales of all important pigments except white lead and by lower sales values of the lead pigment group. The higher average values received for zinc pigments in a small measure offset the drop in tonnage for this group.

[1] Bureau of Foreign and Domestic Commerce, World Trade Notes on Chemicals and Allied Products: Vol. 12, No. 23, June 4, 1938, p. 400.

[2] Robertson, D. W., and Hoback, W. H., Survey of House Paint Primer Technology: Paint, Oil, and Chem. Rev., vol. 100, No. 3, Feb. 3, 1938, pp. 1, 16, 18, and 38.
Oil, Paint, and Drug Reporter, White Pigments in Enamel Tints: Vol. 134, No. 18, Oct. 31, 1938, p. 44.

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*Lead pigments.*—Sales of all lead pigments except white lead in oil declined in 1938. White lead (dry) sales dropped 12 percent but the 7-percent increase in sales of white lead in oil was sufficient to explain a 1-percent increase in total white lead sales. Red lead sales were 11 percent lower and those for litharge and basic lead sulfate 18 percent and 33 percent lower, respectively. The figures for basic lead sulfate do not represent a true picture of the quantities of this pigment consumed, as they are exclusive of the amounts used in the manufacture of leaded zinc oxide. This use of basic lead sulfate has expanded sharply in recent years, and in 1938 about 7,000 tons was so consumed. Litharge made the best showing in relation to 1925–29 averages, the total for 1938 representing 81 percent of the average for 1925–29, while sales of red lead and white lead (dry and in oil) were 73 and 64 percent, respectively.

*Lead pigments sold by domestic manufacturers in the United States, 1937–38*

| Pigment | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Value (at plant, exclusive of container) | | Short tons | Value (at plant, exclusive of container) | |
| | | Total | Average | | Total | Average |
| Basic lead sulfate or sublimed lead: | | | | | | |
| White | 7,514 | $973,214 | $130 | 5,030 | $555,203 | $110 |
| Blue | 1,108 | 147,298 | 133 | 771 | 88,873 | 115 |
| Red lead | 33,931 | 5,429,182 | 160 | 30,183 | 4,121,428 | 137 |
| Orange mineral | 206 | 49,356 | 240 | 127 | 27,547 | 217 |
| Litharge | 83,902 | 12,033,949 | 143 | 68,711 | 8,359,629 | 122 |
| White lead: | | | | | | |
| Dry | 32,661 | 4,576,337 | 140 | 28,583 | 3,533,452 | 124 |
| In oil [1] | 65,552 | 12,466,396 | 190 | 70,400 | 11,517,656 | 164 |

[1] Weight of white lead only but value of paste.

*Lead pigments sold by domestic manufacturers in the United States, 1934–38, in short tons*

| Year | White lead | | Basic lead sulfate or sublimed lead | | Red lead | Orange mineral | Litharge |
|---|---|---|---|---|---|---|---|
| | Dry | In oil | White | Blue | | | |
| 1934 | 22,569 | 56,165 | 6,399 | 668 | 26,743 | 234 | 68,733 |
| 1935 | 27,972 | 68,859 | 7,572 | 727 | 28,776 | 252 | 79,930 |
| 1936 | 34,775 | 83,632 | 7,531 | 891 | 34,896 | 248 | 86,246 |
| 1937 | 32,661 | 65,552 | 7,514 | 1,108 | 33,931 | 206 | 83,902 |
| 1938 | 28,583 | 70,400 | 5,030 | 771 | 30,183 | 127 | 68,711 |

*Zinc pigments and salts.*—Sales of leaded zinc oxide in 1938 were only 5 percent below the record tonnages for 1936 and 1937, but those for lead-free zinc oxide and lithopone fell 31 and 19 percent, respectively, from 1937. Contrary to the trend for other pigments the average values received by producers for zinc oxide and leaded zinc oxide increased in 1938 and were responsible for the smaller decline in total value for zinc pigments than that for lead pigments, despite a larger decrease in total quantity. Sales of leaded zinc oxide in 1938 were 44 percent higher than the average annual sales in 1925–29, while those for zinc oxide and lithopone were lower by 49 and 29 percent, respectively.

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Large amounts of basic lead sulfate are now used in making leaded zinc oxide. Such quantities are included as part of the leaded zinc oxide total and, to avoid duplication, are not shown as basic lead sulfate.

Complete data covering the production of zinc chloride in recent years are not available owing to the refusal of one large producer to supply an accurate report.

Sales of zinc sulfate declined 26 percent from the high record established in 1937.

*Zinc pigments and salts sold by domestic manufacturers in the United States, 1937–38*

| Pigment or salt | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Value (at plant, exclusive of container) | | Short tons | Value (at plant, exclusive of container) | |
| | | Total | Average | | Total | Average |
| Zinc oxide [1] | 114,652 | $11,777,131 | $103 | 79,129 | $9,253,342 | $117 |
| Leaded zinc oxide [1] | 40,343 | 4,190,952 | 104 | 38,216 | 4,072,422 | 107 |
| Lithopone | 154,771 | 12,069,790 | 78 | 125,746 | 9,975,012 | 79 |
| Zinc chloride, 50° B | (2) | (2) | (2) | (2) | (2) | (2) |
| Zinc sulfate | 10,521 | 589,017 | 56 | 7,757 | 439,479 | 57 |

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide.
[2] Data not available.

*Zinc pigments and salts sold by domestic manufacturers in the United States, 1934–38, in short tons*

| Year | Zinc oxide | Leaded zinc oxide | Lithopone | Zinc chloride (50° B.) | Zinc sulfate |
|---|---|---|---|---|---|
| 1934 | 87,088 | 20,506 | 145,565 | 19,614 | [1] 7,379 |
| 1935 | 99,697 | 29,976 | 159,486 | (2) | [1] 7,892 |
| 1936 | 126,800 | 40,512 | 158,319 | (2) | [1] 9,721 |
| 1937 | 114,652 | 40,343 | 154,771 | (2) | 10,521 |
| 1938 | 79,129 | 38,216 | 125,746 | (2) | 7,757 |

[1] Revised figures.
[2] Data not available.

## CONSUMPTION BY INDUSTRIES

*White lead.*—Sales of white lead (dry and in oil) withstood unsatisfactory marketing conditions in 1938 better than other lead and zinc pigments. The total increased 1 percent compared with declines of 5 to 31 percent in the other principal pigments. About 95 percent of the white lead made is used in the manufacture of paint. The quantity consumed for this purpose in 1938 was relatively unchanged from 1937 but amounted to only 69 percent of the tonnage so used in 1929. Early in 1939 the Lead Industries Association announced a 3-year promotion campaign designed to increase the use of white lead paint. The campaign will include identification of white lead as "the most durable." Increased consumption of white lead paint would benefit the lead industry more than increases in almost any other use, for metal so used is dissipated, whereas that used in storage batteries, cable coverings, building, and for similar purposes returns to the market as scrap.

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*Distribution of white lead (dry and in oil) sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Paint | 75,008 | 91,297 | 113,363 | 93,580 | 93,788 |
| Ceramics | 1,434 | 1,834 | 2,653 | 2,506 | 1,918 |
| Other | 2,292 | 3,700 | 2,391 | 2,127 | 3,277 |
| | 78,734 | 96,831 | 118,407 | 98,213 | 98,983 |

*Basic lead sulfate.*—The outstanding use of basic lead sulfate is in the manufacture of paint, and 87 percent of the amount reported for 1938 was sold for that purpose. Increasing quantities of this pigment are being used annually in making leaded zinc oxide. The amounts so used are included in the totals for leaded zinc oxide and excluded from the totals for basic lead sulfate to avoid duplication in the reporting of lead tonnages. In 1938, 7,000 tons of basic lead sulfate were used in making leaded zinc oxide compared with 5,500 tons in 1937.

*Distribution of basic lead sulfate sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Paints | 6,611 | 7,770 | 8,124 | 8,255 | 5,024 |
| Rubber | 93 | 155 | 126 | 213 | 91 |
| Storage batteries | 139 | ---- | 28 | 6 | 3 |
| Other | 224 | 374 | 144 | 148 | 683 |
| | 7,067 | 8,299 | 8,422 | 8,622 | 5,801 |

*Litharge.*—Although total sales of litharge fell 18 percent in 1938 the quantity sold for use in the manufacture of storage batteries—the principal use of this pigment—was maintained at the 1937 rate. All other uses except linoleum showed more than the average drop from 1937. Less lead oxide was used in making batteries, however, for the output of black oxide or suboxide of lead by battery manufacturers declined from the peak output of 42,000 tons in 1937 to 32,000 tons in 1938. The figures on black oxide are not included in Bureau of Mines totals for litharge. Since 1931 insecticides have been the second most important use of litharge. In 1938 sales for this purpose declined 36 percent from the high record established in 1937. Information received in 1939 made it necessary to revise the figures covering distribution of sales of litharge by uses for 1934–37, as will be noted from a comparison of the following table and that on this subject on page 159 of Minerals Yearbook, 1938. Sales of litharge for use in chrome pigments for that period have been overstated, and those for varnish and paints have been understated.

*Distribution of litharge sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Storage batteries | 30,024 | 36,067 | 38,700 | 32,228 | 32,514 |
| Insecticides | 12,271 | 14,665 | 14,662 | 18,242 | 11,736 |
| Oil refining | 7,614 | 7,869 | 7,259 | 8,311 | 6,411 |
| Ceramics | 6,696 | 6,751 | 7,762 | 7,577 | 5,889 |
| Chrome pigments | [1] 5,084 | [1] 6,617 | [1] 6,662 | [1] 7,330 | 4,590 |
| Varnish | [1] 1,492 | [1] 1,610 | [1] 4,247 | [1] 3,366 | 2,449 |
| Rubber | 2,466 | 3,171 | 2,147 | 1,659 | 880 |
| Linoleum | [1] 88 | [1] 220 | [1] 254 | [1] 264 | 231 |
| Other | [1] 2,998 | [1] 2,960 | [1] 4.553 | [1] 4,925 | 4,011 |
| | 68,733 | 79,930 | 86,246 | 83,902 | 68,711 |

[1] Revised figures.

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*Red lead.*—The principal use of red lead is in the manufacture of storage batteries, and the quantity employed for that purpose declined only 6 percent in 1938 compared with a drop of 11 percent in total red lead sales. A new process for the manufacture of this product was reported in a lecture at Birmingham, England, and is described briefly in the Oil, Paint, and Drug Reporter.[3] The process consists of direct vaporization of pure lead in an electric arc furnace and passing of the lead vapor into a precipitating chamber where it mixes with pure oxygen and, with temperature, pressure, and feeds under control, produces the new-type red lead. Higher corrosion-resisting properties and almost twice the covering qualities of standard red lead are claimed for the new commodity. A plant that will use this process was erected at Beeston, England.

*Distribution of red lead sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Storage batteries | 15,987 | 17,657 | 20,323 | 20,275 | 19,057 |
| Paints | 8,766 | 8,721 | 11,786 | 10,440 | 8,698 |
| Ceramics | 595 | 867 | 807 | 854 | 655 |
| Other | 1,395 | 1,531 | 1,980 | 2,362 | 1,773 |
| | 26,743 | 28,776 | 34,896 | 33,931 | 30,183 |

*Orange mineral.*—Sales of orange mineral fell 38 percent in 1938. The principal use shifted back to color pigments again after ink manufacture had ranked first for the 1 year—1937.

*Distribution of orange mineral sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Ink manufacture | 24 | 85 | 71 | 76 | 20 |
| Color pigments | 68 | 125 | 77 | 51 | 94 |
| Other | 142 | 42 | 100 | 79 | 13 |
| | 234 | 252 | 248 | 206 | 127 |

*Zinc oxide.*—The principal use of zinc oxide is in the manufacture of rubber, and sales for that purpose declined in the same proportion as total sales—31 percent. Sales for use in paints fell only 25 percent; but those for floor coverings and textiles, which gained against the trend in 1937, had the sharpest drop of all—66 percent. Ceramics withstood the downtrend well, declining only 6 percent. Of the production for 1938, 62 percent was made by the American process and 38 percent by the French process compared with 69 and 31 percent, respectively, in 1937. The ratio of American to French process zinc oxide in 1937 is believed to have been unduly high, owing to the tight situation regarding supplies of metal during part of that year, and the ratio in 1938 continues above that for other recent years. The proportion of French-process oxide made from scrap zinc increased again, rising from 25 percent in 1937 to 32 percent in 1938. A large amount of zinc oxide is used in the manufacture of leaded zinc oxide. This tonnage is included in the totals for leaded zinc oxide and is excluded

[3] Oil, Paint, and Drug Reporter, New-Process Red Lead: Vol. 133, No. 24, June 13, 1938, p. 61.

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from zinc oxide totals to avoid duplication in the reporting of zinc tonnages. Zinc oxide uses in paint were discussed by Nelson.[4]

*Distribution of zinc oxide sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Rubber | 50,145 | 57,734 | 72,885 | 67,061 | 46,266 |
| Paints | 23,741 | 25,289 | 33,149 | 27,987 | 20,884 |
| Ceramics | 2,963 | 4,028 | 6,102 | 5,216 | 4,908 |
| Floor coverings and textiles | 4,781 | 7,179 | 7,178 | 9,019 | 3,030 |
| Other | 5,458 | 5,467 | 7,486 | 5,369 | 4,041 |
| | 87,088 | 99,697 | 126,800 | 114,652 | 79,129 |

*Leaded zinc oxide.*—The manufacture of paint uses virtually all the leaded zinc oxide made, 98 or more percent being consumed regularly for this purpose. This pigment has become increasingly popular in recent years, and sales thereof were at a record high level in 1936 and 1937. In 1938 sales declined 5 percent, a smaller decline than was indicated for any other pigment except white lead. The total for 1938 includes about 7,000 tons of basic lead sulfate used to increase the lead content of this product; this tonnage is excluded from basic lead sulfate totals to avoid duplication in reporting metal tonnages. Leaded zinc oxide was discussed by Eide and Depew.[5]

*Distribution of leaded zinc oxide sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Paints | 20,376 | 29,632 | 40,156 | 39,584 | 37,348 |
| Rubber | 28 | 36 | 32 | 97 | ---------- |
| Other | 102 | 308 | 324 | 662 | 868 |
| | 20,506 | 29,976 | 40,512 | 40,343 | 38,216 |

*Lithopone.*—Sales of lithopone in 1938 dropped 19 percent from those in 1937. The percentage of the total used in the manufacture of paint has increased in recent years; it was 73 percent in 1929, 79 in 1937, and 81 in 1938. Lithopone statistics are given on the basis of the regular lithopone content of high-strength lithopone plus normal lithopone sold as such. Prior to 1936 the figures were on the basis of standard-strength plus high-strength product. Data showing the increased use of high-strength lithopone are not available. Use of lithopone by the floor coverings and textiles and by the rubber industries fell considerably more in proportion than the total. On the basis of somewhat incomplete information, separation of the amounts shown in the following table for floor coverings and textiles indicates that 10,800 tons were for linoleum and felt-base floor coverings and the remainder for coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.). "Other uses" in 1938 included 1,352 tons used for paper and 477 tons for printing ink.

[4] Nelson, Harley A., Zinc Oxide Uses in Paint: Oil, Paint, and Drug Reporter, vol. 135, No. 14, Apr. 3, 1939, pp. 5, 34.

[5] Eide, A. C., and Depew, Harlan A., Leaded Zinc Oxides—Their Composition, Properties and Manufacture: Drugs, Oils and Paints, vol. 54, No. 4, April 1939, pp. 119–122, 124.

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*Distribution of lithopone sales, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Paints, etc. | 114,472 | 124,615 | 122,461 | 122,915 | 101,924 |
| Floor coverings and textiles | 14,811 | 19,440 | 23,085 | 20,194 | 15,400 |
| Rubber | 4,596 | 4,435 | 4,908 | 4,383 | 3,148 |
| Other | 11,686 | 10,996 | 7,865 | 7,279 | 5,274 |
| | 145,565 | 159,486 | 158,319 | 154,771 | 125,746 |

The use of ordinary-strength lithopone in the manufacture of titanated lithopone, which usually contains about 15 percent $TiO_2$, has increased sharply since the output of this product began. There was a drop in 1938, however, when 17,000 tons were used for this purpose compared with 19,400 tons in 1937.

*Zinc sulfide.*—Production of zinc sulfide was reported by four plants in 1938; but owing to the fact that one producer represents such a large part of the total, the Bureau of Mines cannot publish representative statistics. Most of the zinc sulfide is mixed with regular lithopone to make high-strength lithopone.

*Zinc chloride.*—The Bureau of Mines cannot report zinc chloride production because of the refusal of one of the large producers to supply reliable data.

Complete data on sales of zinc chloride are not available, but returns from producers representing two-thirds or more of the output indicate the following distribution of sales by uses in 1938:

| | Percent | | Percent |
|---|---|---|---|
| Soldering flux | 40 | Oil refining | 4 |
| Wood preserving | 24 | Others | 7 |
| Dry-cell batteries | 14 | | |
| Vulcanized fiber | 11 | | 100 |

*Zinc sulfate.*—The trend of sales of zinc sulfate was upward from 1932 to 1937, and a new high record rate was established in 1937. In 1938 sales fell 26 percent from those in 1937. Efforts to obtain figures covering the distribution of sales of zinc sulfate were more successful in 1938 than in previous years. Of the total sales (7,757 tons), 2,851 tons were reported as sold to the rayon industry, 1,664 tons for agricultural purposes, 947 tons for chemicals, 656 tons to paint and varnish manufacturers, 285 tons for glue manufacture, 284 tons to electrogalvanizers, and 59 tons to printers and dyers of textiles; 948 tons were undistributed.

## RAW MATERIALS USED IN THE MANUFACTURE OF LEAD AND ZINC PIGMENTS AND SALTS

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such miscellaneous secondary materials as scrap and waste from various industrial processes. In 1938, 93 percent of the lead in lead pigments was derived from pig lead and 7 percent from ore. The proportions for zinc pigments in 1938 were 67 percent from ore, 15 percent from slab zinc, and 18 percent from secondary materials.

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*Metal content of lead and zinc pigments produced by domestic manufacturers, 1937–38, by sources, in short tons*

| Source | 1937 | | 1938 | |
|---|---|---|---|---|
| | Lead in pigments [1] | Zinc in pigments | Lead in pigments [1] | Zinc in pigments |
| Domestic ore | 17,363 | [2] 110,517 | 12,025 | 68,168 |
| Metal | 204,961 | 24,594 | 162,828 | 15,760 |
| Secondary material [3] | 127 | 21,526 | ---------- | 18,718 |
| | 222,451 | [2] 156,637 | 174,853 | 102,646 |

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.
[2] Revised figures.
[3] Zinc ashes, skimmings, drosses, and old metal.

The following tables give the source of the metal used in the manufacture of each pigment and salt. Pig lead is employed exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral, as well as in the manufacture of basic lead sulfate. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulfate, and basic lead sulfate. A substantial proportion of the zinc in lithopone and zinc chloride made in the United States is derived from secondary material. There has been a decided increase in the quantity of secondary zinc consumed in the manufacture of zinc oxide since 1933. This material has displaced slab zinc in the manufacture of French-process oxide.

*Lead content of lead and zinc pigments produced by domestic manufacturers, 1937–38, by sources, in short tons*

| Pigment | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Lead in pigments produced from— | | | Total lead in pigments | Lead in pigments produced from— | | | Total lead in pigments |
| | Domestic ore | Pig lead | Secondary material | | Domestic ore | Pig lead | Secondary material | |
| White lead | --------- | 90,791 | --------- | 90,791 | --------- | 74,128 | --------- | 74,128 |
| Red lead | --------- | 32,986 | --------- | 32,986 | --------- | 26,608 | --------- | 26,608 |
| Litharge | --------- | 79,704 | --------- | 79,704 | --------- | 60,509 | --------- | 60,509 |
| Orange mineral | --------- | 237 | --------- | 237 | --------- | 91 | --------- | 91 |
| Basic lead sulfate | 5,555 | 977 | --------- | 6,532 | 2,830 | 739 | --------- | 3,569 |
| Leaded zinc oxide | 11,808 | 266 | 127 | 12,201 | 9,195 | 753 | --------- | 9,948 |
| | 17,363 | 204,961 | 127 | 222,451 | 12,025 | 162,828 | --------- | 174,853 |

*Zinc content of zinc pigments and salts produced by domestic manufacturers, 1937–38, by sources, in short tons*

| Pigment or salt | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Zinc in pigments and salts produced from— | | | Total zinc in pigments and salts | Zinc in pigments and salts produced from— | | | Total zinc in pigments and salts |
| | Domestic ore | Slab zinc | Secondary material | | Domestic ore | Slab zinc | Secondary material | |
| Zinc oxide | 70,607 | 24,052 | 8,228 | 102,887 | 37,069 | 15,713 | 7,456 | 60,238 |
| Leaded zinc oxide | 20,666 | 542 | 258 | 21,466 | 18,502 | --------- | --------- | 18,502 |
| Lithopone | [1] 19,244 | --------- | 13,040 | [1] 32,284 | 12,597 | 47 | 11,262 | 23,906 |
| Zinc sulfide | [2] | --------- | [2] | [2] | [2] | --------- | [2] | [2] |
| Zinc chloride | [2] | [2] | [2] | [2] | [2] | [2] | [2] | [2] |
| Zinc sulfate | 1,105 | --------- | 1,735 | 2,840 | 931 | --------- | 1,395 | 2,326 |

[1] Revised figures. [2] Data not available.

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## PRODUCERS AND PLANTS

The following companies sold or used lead and zinc pigments and zinc salts of their own production in 1938:

| | |
|---|---|
| White lead: | |
| The Eagle-Picher Lead Co | Cincinnati, Ohio. |
| Euston Lead Co | Scranton, Pa. |
| W. P. Fuller & Co | South San Francisco, Calif. |
| International Smelting and Refining Co. (electrolytic process). | East Chicago, Ind. |
| John T. Lewis & Bros. Co | Philadelphia, Pa. |
| National Lead Co | Melrose, Calif. |
| Do. (2 plants) | Chicago, Ill. |
| Do | St. Louis, Mo. |
| Do | Perth Amboy, N. J. |
| Do | Brooklyn, N. Y. |
| Do | Port Richmond, N. Y. |
| The Sherwin-Williams Co | Chicago, Ill. |
| Basic lead sulfate, or sublimed lead: | |
| The Eagle-Picher Mining & Smelting Co | Galena, Kans. |
| National Lead Co | St. Louis, Mo. |
| Red lead, orange mineral, and litharge: | |
| The Andrews Lead Co., Inc | Long Island City, N. Y. |
| E. I. du Pont de Nemours and Co | East Chicago, Ind. |
| The Eagle-Picher Lead Co | Joplin, Mo. |
| Do | Newark, N. J. |
| The Eagle-Picher Mining & Smelting Co | Galena, Kans. |
| W. P. Fuller & Co | South San Francisco, Calif. |
| Hammond Lead Products, Inc | Hammond, Ind. |
| Morris P. Kirk & Son | Los Angeles, Calif. |
| John T. Lewis & Bros. Co | Philadelphia, Pa. |
| Metals Refining Division of the Gidden Co. | Hammond, Ind. |
| National Lead Co | Melrose, Calif. |
| Do | Chicago, Ill. |
| Do | St. Louis, Mo. |
| Do | Brooklyn, N. Y. |
| Do | Charleston, W. Va. |
| The Sherwin-Williams Co | Chicago, Ill. |
| United Color & Pigment Co | Newark, N. J. |
| Zinc oxide and leaded zinc oxide: | |
| American Zinc Co. of Illinois | Hillsboro, Ill. |
| American Zinc Oxide Co | Columbus, Ohio. |
| The Eagle-Picher Lead Co | Hillsboro, Ill. |
| International Smelting and Refining Co. (French process). | East Chicago, Ind. |
| Do | Akron, Ohio. |
| Morris P. Kirk & Son | Los Angeles, Calif. |
| Monsanto Chemical Co | St. Louis, Mo. |
| The New Jersey Zinc Co. (of Pennsylvania) | Palmerton, Pa. |
| Do. (French process) | Freemansburg, Pa. |
| The Ozark Smelting & Mining Division of The Sherwin-Williams Co. | Coffeyville, Kans. |
| Röhm & Haas Co | Bristol, Pa. |
| St. Joseph Lead Co. of Pennsylvania | Monaca, Pa. |
| Superior Zinc Corp | Bristol, Pa. |
| Lithopone: | |
| The Chemical & Pigment Co | Oakland, Calif. |
| Do | Collinsville, Ill. |
| Do | St. Helena, Md. |
| E. I. du Pont de Nemours and Co | Newport, Del. |
| Do | Newark, N. J. |

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| | |
|---|---|
| Lithopone—Continued. | |
| The Eagle-Picher Lead Co | Argo, Ill. |
| Mineral Point Zinc Division of The New Jersey Zinc Co | Depue, Ill. |
| The New Jersey Zinc Co. (of Pennsylvania) | Palmerton, Pa. |
| The Ozark Smelting & Mining Division of The Sherwin-Williams Co | Coffeyville, Kans. |
| The Sherwin-Williams Co | Chicago, Ill. |
| United Color & Pigment Co | Newark, N. J. |
| Zinc sulfide: | |
| American Zinc Oxide Co | Columbus, Ohio. |
| Mineral Point Zinc Division of The New Jersey Zinc Co | Depue, Ill. |
| The New Jersey Zinc Co. (of Pennsylvania) | Palmerton, Pa. |
| The Ozark Smelting & Mining Division of The Sherwin-Williams Co | Coffeyville, Kans. |
| Zinc salts: | |
| American Smelting and Refining Co | Selby, Calif. |
| Do | Federal, Ill. |
| Do | Omaha, Nebr. |
| Do | Perth Amboy, N. J. |
| Do | Pittsburgh, Pa. |
| Atlas Powder Co | Atlas, Mo. |
| The Chemical & Pigment Co | Oakland, Calif. |
| Charles Cooper & Co., Inc | Newark, N. J. |
| E. I. du Pont de Nemours and Co | East Chicago, Ind. |
| Do | Cleveland, Ohio. |
| Do | Weirton, W. Va. |
| General Chemical Co | Chicago, Ill. |
| Great Western Electro-Chemical Co | Pittsburg, Calif. |
| Jordan Co | Chicago, Ill. |
| Morris P. Kirk & Son | Los Angeles, Calif. |
| Mallinckrodt Chemical Works | St. Louis, Mo. |
| Merrimac Division of Monsanto Chemical Co. | Everett, Mass. |
| The Ozark Smelting & Mining Division of The Sherwin-Williams Co | Coffeyville, Kans. |
| Pacific Smelting Inc., Ltd | Torrance, Calif. |
| Röhm & Haas Co | Bridesburg, Pa. |
| The Ruby Chemical Co | Columbus, Ohio. |
| Virginia Smelting Co | West Norfolk, Va. |

## PRICES

The total values reported by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. The average values received for important lead pigments dropped from 11 to 15 percent, while those for zinc pigments were relatively stationary or increased up to 14 percent. The range of market quotations, as reported by the Oil, Paint, and Drug Reporter, appears in the following table. The prices for lead pigments in general followed that for pig lead, declining to the low point of the year in the middle of the year and rising in the third quarter. Quoted prices for lithopone, zinc chloride, and zinc sulfate were relatively unchanged from those for 1937, while prices for zinc oxide in general remained throughout the year at the best levels reached in 1937.

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*Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1935–38, in cents per pound*

| Product | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| Basic lead sulfate, or sublimed lead, less than carlots, barrels | 6.25 | 6.25– 6.75 | 6.50– 8.75 | 5.50– 6.50 |
| White lead, or basic lead carbonate, dry, carlots, barrels | 6.50 | 6.50– 7.25 | 6.75– 9.00 | 6.00– 7.00 |
| Litharge, commercial, powdered, barrels | 6.00– 7.00 | 6.00– 8.50 | 6.25–10.00 | 5.50– 7.50 |
| Red lead, dry, 95 percent or less, less than carlots, barrels | 7.00– 8.00 | 7.50– 9.50 | 7.75–11.00 | 7.00– 8.50 |
| Orange mineral, American, small lots, barrels: | | | | |
| Ex-white lead | 9.50–11.00 | 10.50–11.25 | 10.25–13.50 | 9.50–11.00 |
| Ex-red lead | 9.00–10.50 | 10.50–11.25 | | |
| Zinc oxide: | | | | |
| American process, lead-free, bags, carlots | 5.00– 6.50 | 5.00– 5.25 | 5.25– 7.50 | 6.25– 7.50 |
| American process, 5 to 35 percent lead, barrels, carlots | 5.13– 6.50 | 5.13– 5.38 | 5.38– 6.88 | 5.90– 6.38 |
| French process, red seal, bags, carlots | 5.50– 8.38 | 5.50– 5.75 | 5.75– 7.50 | 7.50 |
| French process, green seal, bags, carlots | 6.00– 9.38 | 6.00– 6.25 | 6.25– 8.00 | 8.00 |
| French process, white seal, barrels, carlots | 6.50–10.63 | 6.50– 6.75 | 7.00– 8.75 | 8.75 |
| Lithopone, domestic, 5-ton lots, bags | 4.50 | 4.25– 4.50 | 4.25– 4.63 | 4.38– 4.63 |
| Zinc sulfide, less than carlots, bags, barrels | 10.50–11.75 | 9.25–11.75 | 9.25– 9.50 | 8.63– 9.50 |
| Zinc chloride, works: | | | | |
| Solution, tanks | 2.00 | 2.00 | 2.00– 2.25 | 2.25 |
| Fused, drums | 4.50– 5.75 | 4.25– 5.75 | 4.25– 5.75 | 4.25– 5.75 |
| Zinc sulfate, crystals, barrels | 2.65– 2.80 | 2.65– 3.95 | 2.80– 4.05 | 2.65– 4.05 |

## FOREIGN TRADE [6]

Imports of lead and zinc pigments decreased 32 percent and exports 29 percent in value in 1938. The excess value of exports over imports amounted to $554,000; it was only slightly more than one-fifth of the annual average for 1925–29. The value of imports of lead and zinc salts was less than one-half that in 1937, while the value of exports of lead arsenate, the only salt separately recorded, increased.

The following table shows the values of various pigments and salts imported and exported in 1937 and 1938.

*Value of foreign trade of the United States in lead and zinc pigments and salts, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Imports | Exports | Imports | Exports |
| Lead pigments: | | | | |
| White lead | $6,677 | $207,381 | $3,979 | $190,745 |
| Red lead | 285 | 158,923 | 79 | 115,348 |
| Litharge | 31 | 220,134 | 123 | 203,610 |
| Orange mineral | 928 | (1) | 271 | (1) |
| Other lead pigments | 9,406 | (1) | 5,533 | (1) |
| | 17,327 | 586,438 | 9,985 | 509,703 |
| Zinc pigments: | | | | |
| Zinc oxide | 97,686 | 378,332 | 73,487 | 185,848 |
| Lithopone | 302,417 | 231,622 | 207,115 | 153,567 |
| Zinc sulfide | 13,856 | (1) | 4,798 | (1) |
| | 413,959 | 609,954 | 285,400 | 339,415 |
| Lead and zinc salts: | | | | |
| Lead arsenate | 42 | 91,377 | ---------- | 95,196 |
| Other lead compounds | 36,615 | (1) | 12,659 | (1) |
| Zinc chloride | 44,191 | (1) | 19,718 | (1) |
| Zinc sulfate | 29,966 | (1) | 16,321 | (1) |
| | 110,814 | 91,377 | 48,698 | 95,196 |
| Grand total | 542,100 | 1,287,769 | 344,083 | 944,314 |

[1] Data not available.

[6] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Lead pigments and salts.*—Imports of these commodities are insignificant. The most important item is the group of lead compounds, which include lead acetate, lead nitrate, and others, but imports of these compounds fell from 213 tons in 1937 to 85 in 1938. Imports of suboxide of lead fell from 28 tons in 1937 to 16 in 1938.

*Lead pigments and salts imported for consumption in the United States, 1934–38, in short tons*

| Year | Basic carbonate white lead | Red lead | Litharge | Orange mineral | Lead compounds | Total value |
|---|---|---|---|---|---|---|
| 1934 | 15 | ---- | (1) | 5 | 183 | [2] $29,425 |
| 1935 | 6 | 1 | ---- | 2 | 302 | [2] 38,228 |
| 1936 | 32 | 2 | 1 | 5 | 185 | [2] 37,878 |
| 1937 | 34 | 1 | (1) | 5 | 213 | [2] 53,984 |
| 1938 | 20 | 1 | 1 | 2 | 85 | [2] 22,644 |

[1] Less than 1 ton.
[2] Includes also—1934: Lead pigments, n. s. p. f., $18 (200 pounds), sublimed lead (basic sulfate) $39 (10 pounds); 1935: Lead pigments, n. s. p. f., $478 (4,405 pounds); 1936: Lead pigments, n. s. p. f., $19 (33 pounds), sublimed lead (basic sulfate) $9 (15 pounds), and suboxide of lead, n. s. p. f., $5,264 (39,010 pounds); 1937: Lead pigments, n. s. p. f., $8 (100 pounds), sublimed lead (basic sulfate), $2 (10 pounds), and suboxide of lead, n. s. p. f., $9,396 (55,453 pounds); 1938: Lead pigments, n. s. p. f., $198 (2,330 pounds), and suboxide of lead, n. s. p. f., $5,335 (31,834 pounds).

The principal exports are white lead and litharge, and these two items increased in 1938, although not significantly. Exports of red lead and lead arsenate declined in 1938. Exports of white lead, red lead, and litharge comprised less than 2 percent of domestic production of these pigments.

White lead was exported principally to the Philippine Islands, Netherlands, and Canada, while red lead and litharge were exported mainly to Canada, the Philippines, and Netherland West Indies.

*Lead pigments and salts exported from the United States, 1934–38, in short tons*

| Year | White lead | Red lead | Litharge | Lead arsenate | Total value |
|---|---|---|---|---|---|
| 1934 | 1,561 | 745 | 972 | 325 | $457,273 |
| 1935 | 2,337 | 750 | 1,280 | 578 | 606,734 |
| 1936 | 1,862 | 810 | 1,386 | 414 | 609,890 |
| 1937 | 1,236 | 934 | 1,452 | 521 | 677,815 |
| 1938 | 1,411 | 806 | 1,694 | 511 | 604,949 |

*White lead, red lead, and litharge exported from the United States, 1935–38, by destinations, in short tons*

| Destination | White lead | | | | Red lead and litharge | | | |
|---|---|---|---|---|---|---|---|---|
| | 1935 | 1936 | 1937 | 1938 | 1935 | 1936 | 1937 | 1938 |
| Countries: | | | | | | | | |
| Argentina | 98 | 126 | 89 | 97 | 162 | 139 | 204 | 359 |
| Canada | 56 | 74 | 126 | 220 | 502 | 544 | 703 | 542 |
| Netherlands | 827 | 387 | 83 | 222 | 2 | 43 | ---- | ---- |
| Netherland West Indies | 3 | 3 | 5 | 5 | 81 | 273 | 287 | 400 |
| Panama | 205 | 453 | 206 | 108 | 53 | 53 | 76 | 78 |
| Philippine Islands | 190 | 170 | 272 | 385 | 287 | 342 | 353 | 406 |
| United Kingdom | 93 | 13 | 23 | 22 | 2 | 17 | 20 | 9 |
| Others | 865 | 636 | 432 | 352 | 941 | 785 | 743 | 706 |
| | 2,337 | 1,862 | 1,236 | 1,411 | 2,030 | 2,196 | 2,386 | 2,500 |
| Continents: | | | | | | | | |
| North America | 441 | 754 | 479 | 448 | 930 | 1,140 | 1,379 | 1,275 |
| South America | 202 | 218 | 170 | 221 | 402 | 344 | 374 | 494 |
| Europe | 1,242 | 707 | 232 | 279 | 139 | 220 | 157 | 105 |
| Asia | 285 | 174 | 336 | 450 | 335 | 407 | 413 | 494 |
| Africa | 166 | 9 | 18 | 13 | 224 | 61 | 63 | 131 |
| Oceania | 1 | (1) | 1 | (1) | (1) | 24 | (1) | 1 |

[1] Less than 1 ton.



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*Zinc pigments and salts.*—Imports of all items shown under this heading declined in 1938. Lithopone ranks as the most important zinc pigment imported, although imports of this commodity represented only 3 percent of domestic sales in 1938. Imports of zinc oxide (dry and in oil) totaled 645 tons, a decline from 775 tons in 1937

*Zinc pigments and salts imported for consumption in the United States, 1934–38, in short tons*

| Year | Zinc oxide | | Lithopone | Zinc sulfide | Zinc chloride | Zinc sulfate | Total value |
|---|---|---|---|---|---|---|---|
| | Dry | In oil | | | | | |
| 1934 | 1,204 | 64 | 3,927 | 12 | 382 | 140 | $404,25 |
| 1935 | 1,932 | 59 | 4,603 | 16 | 564 | 135 | 508,47 |
| 1936 | 694 | 96 | 4,781 | 30 | 520 | 385 | 425,49 |
| 1937 | 680 | 95 | 5,601 | 113 | 667 | 593 | 488,11 |
| 1938 | 579 | 66 | 3,932 | 12 | 272 | 392 | 321,43 |

Exports of zinc oxide made a notable gain in 1937 but in 1938 returned to 13 percent below the 1936 level. Shipments of lithopone abroad declined sharply in 1938 and were the smallest recorded since 1933. As usual, Canada was the principal destination of exports of zinc oxide and lithopone, 514 and 1,219 tons, respectively, of the totals of 1,163 and 1,734 tons going to that country in 1938.

*Zinc pigments and salts [1] exported from the United States, 1934–38, in short tons*

| Year | Zinc oxide | Lithopone | Total value | Year | Zinc oxide | Lithopone | Total value |
|---|---|---|---|---|---|---|---|
| 1934 | 1,155 | 2,401 | $395,189 | 1937 | 2,953 | 2,671 | $609,95 |
| 1935 | 1,140 | 2,372 | 392,368 | 1938 | 1,163 | 1,734 | 339,41 |
| 1936 | 1,330 | 2,538 | 419,987 | | | | |

[1] Zinc salts not separately recorded.

*Zinc oxide and lithopone exported from the United States, 1935–38, by destinations in short tons*

| Destination | Zinc oxide | | | | Lithophone | | | |
|---|---|---|---|---|---|---|---|---|
| | 1935 | 1936 | 1937 | 1938 | 1935 | 1936 | 1937 | 1938 |
| Countries: | | | | | | | | |
| Argentina | 35 | 55 | 48 | 86 | 74 | 35 | 63 | 2 |
| Canada | 453 | 704 | 1,583 | 514 | 1,652 | 1,812 | 1,740 | 1,21 |
| Cuba | 115 | 80 | 207 | 48 | 198 | 186 | 258 | 11 |
| France | 15 | 13 | 111 | 49 | 2 | 3 | 1 | |
| United Kingdom | 56 | 80 | 29 | 26 | 138 | 199 | 199 | 10 |
| Others | 466 | 398 | 975 | 440 | 308 | 303 | 410 | 26 |
| | 1,140 | 1,330 | 2,953 | 1,163 | 2,372 | 2,538 | 2,671 | 1,73 |
| Continents: | | | | | | | | |
| North America | 724 | 882 | 1,972 | 659 | 1,969 | 2,104 | 2,184 | 1,48 |
| South America | 78 | 130 | 149 | 117 | 118 | 57 | 90 | 4 |
| Europe | 94 | 99 | 148 | 85 | 140 | 218 | 217 | 13 |
| Asia | 132 | 52 | 467 | 159 | 16 | 25 | 24 | 1 |
| Africa | 5 | 6 | 57 | 3 | 3 | 4 | 1 | |
| Oceania | 107 | 161 | 160 | 140 | 126 | 130 | 155 | 6 |

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# GOLD, SILVER, COPPER, AND LEAD IN ALASKA

(MINE REPORT)

By CHAS. W. HENDERSON

## SUMMARY OUTLINE


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Alaska mines yielded gold, silver, copper, and lead valued in terms of recovered metals at $26,527,315 in 1938 compared with $26,652,698 in 1937, a decrease of less than 0.5 percent. Maintaining a value of gross production in 1938 comparable with that in 1937 was due directly to a 9-percent increase in value of placer gold output; gold production from lode mines remained virtually constant through the 2 years. The value of the copper output decreased 32 percent from 1937, owing to exhaustion of the ore bodies of the two largest copper producers and to the lower average price for refined copper.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.

The following tables show the mine production of gold, silver, copper, and lead in Alaska in 1934–38 and 1880–1938; the output of gold, silver, and lead from amalgamation and cyanidation mills (with or without concentration equipment) in 1938, by regions; and the output of gold and silver in 1938, by types of operation. The Bureau of Mines is not at liberty to publish separately the quantity of ore treated at straight concentration mills and that shipped crude to smelters.



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*Mine production of gold, silver, copper, and lead in Alaska, 1934–38, and total, 1880–1938, in terms of recovered metals*

| Year | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|
| | Fine ounces | Value | Fine ounces | Value |
| 1934 | 537,281.83 | $18,778,000 | 168,868 | $109,167 |
| 1935 | 469,495.00 | 16,432,325 | 286,848 | 206,172 |
| 1936 | 540,580.00 | 18,920,300 | 484,306 | 375,098 |
| 1937 | 627,940.00 | 21,977,900 | 494,340 | 382,372 |
| 1938 | 664,973.00 | 23,274,055 | 479,853 | 310,208 |
| 1880–1938 | 23,023,856.00 | 518,849,562 | 18,978,413 | 13,506,700 |

| Year | Copper | | Lead | | Total value |
|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | |
| 1934 | 114,000 | $9,120 | 1,493,000 | $55,241 | $18,951,528 |
| 1935 | 15,500,000 | 1,286,500 | 1,340,000 | 53,600 | 17,978,597 |
| 1936 | 37,700,000 | 3,468,400 | 1,882,000 | 86,572 | 22,850,367 |
| 1937 | 34,672,000 | 4,195,312 | 1,646,000 | 97,114 | 26,652,698 |
| 1938 | 29,098,000 | 2,851,604 | 1,988,000 | 91,448 | 26,527,315 |
| 1880–1938 | [1] 685,553 | 226,492,936 | [1] 21,763 | 2,413,575 | 761,262,773 |

[1] Short tons.

*Mine production of gold and silver in Alaska in 1938, by types of operation*

| Type of operation | Mines producing | Material treated | Gold | | | Silver | | | Total value |
|---|---|---|---|---|---|---|---|---|---|
| | | | Fine ounces | Percent of total | | Fine ounces | Percent of total | | |
| | | | | 1938 | 1937 | | 1938 | 1937 | |
| Lode mines | 70 | [1] 4,856,719 | 234,018 | 35 | 37 | 416,790 | 87 | 86 | $8,460,070 |
| Floating connected-bucket dredges | [2] 44 | [3] 19,747,660 | 278,442 | 42 | 41 | 39,204 | 8 | 7 | 9,770,814 |
| Placers (dragline and dry-land dredges, hydraulic, drift mining, and sluicing) | [4] 1,120 | ([5]) | 152,513 | 23 | 22 | 23,859 | 5 | 7 | 5,353,379 |
| | 1,234 | | 664,973 | 100 | | 479,853 | 100 | | 23,584,263 |
| Total, 1937 | 1,238 | | 627,940 | | 100 | 494,340 | | 100 | 22,360,272 |

[1] Short tons of ore.
[2] Number of dredges. In addition, there was a floating dredge that produced platinum only.
[3] Cubic yards of gravel (average recovered per yard, $0.49).
[4] Includes all types and sizes of placer operations excluding floating connected-bucket dredges.
[5] Cubic yards of gravel; figures not available.

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Alaska in 1938, by regions, in terms of recovered metals*

| Region | Ore treated | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Cook Inlet-Susitna | 26,360 | 29,834.33 | 1,709 | 454 | 3,998.27 | 268 | (1) | 500 |
| Kenai Peninsula | 1,718 | 1,582.00 | 465 | 12 | 107.00 | 50 | (1) | 280 |
| Kuskokwim | 770 | 908.80 | 184 | | | | | |
| Southeastern Alaska | 4,691,396 | 142,246.51 | 28,756 | 3,088 | 28,352.00 | 104,181 | (1) | 1,933,894 |
| Yukon River Basin | 12,930 | 10,636.60 | 2,012 | 29 | 110.00 | 423 | (1) | 500 |
| | 4,733,174 | 185,208.24 | 33,126 | 3,583 | 32,567.27 | 104,922 | (1) | 1,935,174 |
| Total, 1937 | 4,556,978 | 201,562.77 | 37,227 | 3,446 | 29,771.42 | 100,140 | (1) | 1,641,441 |

[1] Bureau of Mines not at liberty to publish details of copper production.

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*Gold.*—Gold contributed 88 percent of the total value of the gold, silver, copper, and lead produced in Alaska in 1938, an increase from 82 percent in 1937. Floating connected-bucket dredges, of which there were 44 in operation compared with 41 in 1937, contributed the larger part of the increase in gold output; the gold recovered was 9 percent above that in 1937. Increased use of draglines, slack-line scrapers, bulldozers, and floating washing plants in the Seward Peninsula, Yukon Basin, Kuskokwim, and Cook Inlet regions caused the gold output from other types of placer operations (excluding the floating connected-bucket type) to show the largest relative increase (10 percent) but a net increase smaller than that of the dredges. In 1938 there were 99 operators using such mechanical equipment—47 dragline and dry-land dredges, 13 slack-line drag scrapers, 15 caterpillar bulldozers, and 24 using a combination of bulldozers and hydraulic. Production from lode mines was slightly (less than 0.5 percent) lower than in 1937. Nine more lode mines were in active operation, but their added production did not suffice to offset the decline in production at the two largest lode mines in Alaska during 1938.

*Silver.*—The output of recoverable silver in Alaska decreased 14,487 fine ounces from 1937 to 1938. As over 50 percent of the total silver in both years was obtained as a byproduct of copper production, this decrease can be attributed directly to the decline in copper output. No mines in Alaska yielded silver as their principal product.

*Copper.*—The output of recoverable copper in Alaska in 1938 decreased 16 percent from 1937. This decline can be attributed directly to exhaustion of the ore bodies at Kennecott, for many years the largest copper mine in Alaska. The lowering of the average price paid for refined copper did not tend to lower the copper output from the many operations that produced copper as a byproduct of their gold production only.

*Lead.*—Recoverable lead production in Alaska in 1938 increased 21 percent in quantity over 1937 but decreased 6 percent in total value. The value of the lead produced was less than 1 percent of the total value of the gold, silver, copper, and lead. The bulk of the lead is recovered from lead concentrates produced by the Alaska Juneau Gold Mining Co. in the Southeastern Alaska region.

## MARKETS AND METALLURGY

There are no smelters or refineries in Alaska. The bulk of the gold produced is in the form of bullion from placer and lode operations, which is sent finally to the Seattle Assay Office or the San Francisco Mint. Over half of the silver and all the copper and lead produced are obtained from high-grade ore and concentrates shipped to the Tacoma (Wash.) and Selby (Calif.) smelters.

There were 37 mines in Alaska in 1938 equipped with amalgamation or cyanidation plants—ranging in daily capacity from 1 ton to 12,000 tons—that were in continuous operation throughout the year. One mine was equipped with a flotation plant milling copper-palladium ore in the Southeastern Alaska region; one mine was equipped with a flotation- and table-concentration mill for handling copper-silver ore in the Copper River region; and 23 mines were equipped with amalgamation and cyanidation plants (chiefly amalgamation) that ran intermittently during the year. The copper concentrates shipped to

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Tacoma averaged approximately 50 percent in copper content. Gold concentrates from straight concentration mills averaged over 16 ounces of gold and over 21 ounces of silver to the ton.

The gold-silver bullion is sold either direct to the Seattle Assay Office or San Francisco Mint or, first, to one of the many gold bullion buyers in the larger centers of Alaska. These purchasers of gold-silver bullion send it direct to the mint or cast it in bars for shipping; in many cases they act merely as agents for many lode and placer operators. Among the largest purchasers of gold-silver bullion during 1938 were: The First National Bank of Fairbanks, Fairbanks; the Miners and Merchants Bank of Iditarod, Flat; the Miners and Merchants Bank of Alaska, Nome; and the Northern Commercial Co. and the Seattle First National Bank, Seattle (Wash.).

The United States Assay Office, Seattle, Wash., reports the following receipts from Alaska in 1938.

*Bullion of Alaskan origin deposited at United States Assay Office, Seattle, Wash., during year ended Dec. 31, 1938, in fine ounces*

| District | Gold | Silver |
|---|---|---|
| Circle | 16,086.117 | 1,428.22 |
| Cook Inlet | 48,771.753 | 5,001.04 |
| Copper River | 5,758.978 | 1,143.74 |
| Eagle | 5,410.448 | 1,038.22 |
| Iditarod | 49,263.807 | 7,447.20 |
| Koyukuk | 1,664.992 | 119.37 |
| Kuskokwim | 18,063.324 | 1,848.46 |
| Nome | 105,918.145 | 11,995.85 |
| Southeastern Alaska | 141,393.724 | 28,598.44 |
| Tanana [1] | 211,271.634 | 35,038.11 |
| | 603,602.922 | 93,658.65 |

[1] Includes mainly Bonnifield, Fairbanks, Hot Springs, Kantishna, and Tolovana districts in the Yukon Basin region.

## REVIEW BY REGIONS

*Cook Inlet-Susitna region.*—The Cook Inlet-Susitna region, comprising the Prince William Sound, Valdez Creek, Willow Creek, and Yentna-Cache Creek districts, produced 14 percent of the total lode gold output in Alaska during 1938. The bulk of the metal from lodes in this region came from mines in the Willow Creek district.

The Alaska-Pacific Consolidated Mining Co. at Wasilla, operating the Independence and Martin mines, was the largest producer. The bulk of the gold from this operation was in the form of bullion shipped to the Seattle Assay Office. Some high-grade concentrates were shipped to Tacoma during the year.

Willow Creek Mines, Inc., operating the Luckyshot and War Baby mines in the Willow Creek district, was taken over by the Conwest Exploration Co. April 20, 1938, but the latter company did not begin active operations until June 20; the old name, Willow Creek Mines, Inc., was not dropped. The Conwest Exploration Co. milled 2,356 tons of gold ore during the latter part of 1938; the heads averaged 0.75 ounce of gold to the ton. The mill, of 40 tons daily capacity, concentrates crude ore by means of flotation and jigs; the flotation concentrate is cyanided and the jig concentrate is amalgamated.

The Cliff Gold Mining Co., Inc., operating the Cliff mine in the Prince William Sound district and equipped with a 30-ton amalgamation-concentration mill, handled crude ore averaging over $50 to

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the ton in recoverable gold. Bullion was shipped to the Seattle Assay Office through the First Bank of Valdez, and concentrates were shipped to the Tacoma smelter.

Rapp & Till, re-treating impounded tailings from the Gold Bullion mine property of Willow Creek Mines, Inc., made a creditable production.

Other operators making notable production were: The Fern Gold Leasing Co., operating in the Willow Creek district, and the Gold Cord Development Co., operating the Gold Cord mine, also in the Willow Creek district.

There were no floating connected-bucket dredges in the Cook Inlet-Susitna region in 1938. Several producers using hydraulic giants or dragline excavators and portable washing plants made a sizable production. The bulk of the gold from placer operations came from mines in the Yentna-Cache Creek district. Among the leading producers using hydraulic giants, dragline excavators, caterpillar bulldozers, and auxiliary washing plants were: Spokane Peters Creek, Inc., operating on bench gravels on Peters Creek; the Cache Creek Mining Co., operating on Cache Creek; and the Dutch Creek Mining Co., operating on Dutch Creek.

*Copper River region.*—The Copper River region, comprising the Chistochina, Nabesna, Nelchina, and Nizina districts, produced over half of the recoverable silver output and the bulk of the recoverable copper output of Alaska during 1938. The largest producers of copper and silver in this region were the Kennecott Copper Corporation and its subsidiary, the Mother Lode Coalition Mines Co., operating properties at Kennecott. The metal output of these mines was contained in high-grade copper ore and high-grade copper concentrates, from the 900- to 1,100-ton concentrating mill operated by the Kennecott Copper Corporation, shipped to Tacoma; no custom ores were handled. The mines of the Kennecott Copper Corporation and the Mother Lode Coalition Mines Co. were abandoned permanently during the latter part of 1938 owing to exhaustion of the ore bodies.

The Twentieth Annual Report of the Mother Lode Coalition Mines Co. for the year ended December 31, 1938 (dated April 4, 1939), says—

In the midyear statement you were advised that operations at the mine were terminated on July 31, 1938, because of the exhaustion of the ore body. During the 7-month period of operations 16,082 tons of ore containing 2,426 tons of recoverable copper were mined. These tonnages exceed the amount estimated in the last annual report to be contained in the ore reserves on January 1, 1938, by 4,682 tons of ore containing 1,220 tons of recoverable copper.

The unsold copper on hand January 1, 1938, and that mined during the 7-month period of operations, an aggregate of 7,120 tons, was sold before the close of the year.

The net income of the company, after inclusion of miscellaneous other income and the deduction of all costs including taxes, but before depletion, was $508,766.75, which is equal to approximately 20 cents per share on the outstanding capital stock of the company.

In the annual reports for 1936 and 1937 special reference was made to the unsatisfactory outcome of the development and prospecting work which had been carried on by the company. It had also been indicated in previous reports that the results of that work had been most unfavorable and disappointing and that no new ore bodies of commercial grade had been disclosed. Similarly, no new ore body was found during 1938. After the termination of mining operations the mine was closed down and all equipment having any net salvage value was removed from the mine and shipped out for sale. This equipment has not been sold and while the amount of salvage is not determinable at this time it will not be an important item. The 19 patented mining claims to which the company has title continue to be held.

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The Twenty-fourth Annual Report of the Kennecott Copper Corporation for the year ended December 31, 1938 (dated March 21, 1939), makes the following comment on its Alaska property.

The Alaska property was operated until the latter part of October when all ore of commercial value was exhausted and the property closed down. Equipment having any net salvage value was removed and shipped out before abandonment of railroad operations. Production from this property has averaged only 525 tons copper per month since 1928 and therefore cessation of these operations will not affect earnings as this tonnage can easily be made up from other properties.

The Nabesna Mining Corporation, operating the Nabesna mine in the Nabesna mining district, produced the bulk of the output of lode gold in the Copper River region in 1938. The gold and silver recovered were contained in copper concentrates shipped to the Tacoma smelter. The Ninth Annual Report of the Nabesna Mining Corporation for the year ended December 31, 1938, says—

Comparison with last year shows that the most distinctive features of 1938 Nabesna operation have been: Increase of actual mill operating time, larger tonnage treated, better recovery, and a gross production value more than double that of any previous year's record.

The steady and the efficient working of the power plant and mill equipment with only a comparatively small amount of time needed for making repairs, general overhaul, and maintenance work made possible the increase in operating days and the larger tonnage milled.

Better recovery was made by efficient mill operation and alterations in the set-up of the flotation unit and of the reagents used. The closing down of the cyanide plant operation has also contributed to a better over-all recovery and has made possible a considerable saving in operating costs. All of these increases and improvements, together with the higher value of the ore milled, combined to give the larger gross production amount for the year.

Mining and development work were carried on continuously during the year. Work was accomplished on all levels of the mine from the 250- down to the 650-foot level. The Nugget Crosscut on the 250-foot level and the 350-foot level drift received the greater part of the development work. No new ore bodies of any importance have been found during the last few months of the year. During the year as a whole, however, mining development has shown very satisfactory results as to quantities and grade of ore developed. Especially has this been the case with the No. 49 ore body, which was found to extend for over 300 vertical feet above the 450-foot level. Ore has been mined from 53 Stope on the 550-foot level in ore that is the downward extension of the No. 45 ore body from levels above. A vein of medium-grade ore three feet wide has lately been found while extending the Nugget Crosscut farther ahead toward the main line diorite contact.

The winter production of concentrates is being stored at the mine. These will be hauled to Valdez and shipped to the smelter as soon as the road to the coast is open for traffic in the spring.

While the permanent closing of the Copper River & Northwestern railroad will shorten the season in which supplies can be freighted to Nabesna mine by about 2 months, it will otherwise cause no great inconvenience to the operation, as freight can be handled over the Valdez route at less cost than was formerly done via the railroad routing.

*Historical summary of operations of Nabesna Mining Corporation, 1930–38*

| Year | Milled (tons) | Recovered gross value | Mill heads value per ton | Ore milled gross value | Recovery (percent) | Mill operation (days) | Underground work (linear feet) | Diamond drill work (linear feet) |
|---|---|---|---|---|---|---|---|---|
| 1930 | | | | | | | 150 | |
| 1931 | 1,302 | $60,759.53 | $90.00 | $117,180.00 | 50.99 | 60 | 617 | |
| 1932 | 2,022 | 131,978.54 | 83.68 | 169,200.96 | 81.67 | 86 | 412 | |
| 1933 | 2,874 | 141,649.68 | 53.54 | 153,873.96 | 81.40 | 119 | 532 | |
| 1934 | 9,955 | 244,073.69 | 32.86 | 327,121.30 | 74.60 | 170 | 1,868 | 585 |
| 1935 | 16,443 | [1] 247,259.38 | 19.52 | 320,967.36 | 77.03 | 295 | 2,323 | 1,045 |
| 1936 | 11,653 | [1] 190,513.11 | 17.99 | 209,637.47 | 90.88 | 223.7 | 3,203 | 1,292 |
| 1937 | 16,117 | 198,249.04 | 18.00 | 290,145.97 | [2] 68.33 | 284.71 | 1,980 | 695 |
| 1938 | 18,026 | 525,689.98 | 33.65 | 606,629.79 | 86.66 | 312.75 | 2,589 | 1,840 |
| Total, 1930–38 | 78,392 | 1,740,172.95 | 28.00 | 2,194,756.81 | 79.29 | 1,551.16 | 13,674 | 5,457 |

[1] Exclusive of bullion from stacked middlings, as follows: 1935, $10,233.57; 1936, $15,934.70. [2] Over-all.

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There were no floating connected-bucket dredges in the Copper River region in 1938. The output of placer gold came from several small hydraulicking, sluicing, and drift-mining operations scattered throughout the region. The larger producers were: Green Mining Associates, hydraulicking on Boulder Creek in the Nizina district; Chititu Mines, operating on Chititu Creek in the Nizina district; Ahtell Mining Co., hydraulicking on Grubstake Creek in the Chistochina district; Rex Creek Mining Co., operating on Rex Creek near McCarthy; and John Long, operating on Copper Creek about 30 miles from McCarthy.

*Kenai Peninsula region.*—The Girdwood, Moose Pass, Hope, and Nuka Bay districts, included in the Kenai Peninsula region, showed a slight increase in total gold and silver output in 1938 over 1937. The bulk of the output from lode mines consisted of bullion from amalgamation-concentration mills, sent finally to the Seattle Assay Office; some high-grade dry gold concentrates were shipped to Tacoma. The large producers from lode operations in 1938 were: The Crown Point Mining Co., operating the Crown Point mine, and Ralph Reed, leasing the Alaska Oracle mine, both in the Moose Pass-Hope district; the Nuka Alaska Mining Co., operating in the Nuka Bay district; the Crow Creek Gold Corporation, operating the Monarch mine in the Girdwood district; and the Sonny Fox Mining Co., operating the Sonny Fox mine in the Nuka Bay district.

There were no dredging operations in the Kenai Peninsula region during 1938, but the combined output of the several small hydraulicking and sluicing placer operations made a production comparable with that of the lode mines.

*Kodiak Island region.*—The output of gold and silver from the Kodiak Island region during 1938 was confined almost entirely to operation of several small placers.

*Kuskokwim region.*—The bulk of the gold and silver produced in 1938 in the Kuskokwim region, which includes the Goodnews Bay, Nixon Fork, and Tuluksak-Aniak districts, was obtained from the operations of two floating connected-bucket dredges of the New York Alaska Gold Dredging Co. and one dredge of the Bristol Bay Mining Co.; the largest part of the output from dredge operations was produced, as in 1937, by the New York Alaska Gold Dredging Co., using a 2-cubic foot and a 4-cubic foot dredge.

The Bristol Bay Mining Co., using a fuel oil-powered floating connected-bucket dredge with sixty-five 2½-cubic foot buckets, operated from September 21 to October 8, 1938, and handled approximately 22,000 cubic yards of gravel. This dredge was built during the early months of the year and was put into operation during the latter part of the open season.

The Goodnews Bay Mining Co., operating its 1-year-old floating connected-bucket dredge from May 1 to November 12, recovered nearly four times as much platinum as was obtained in 1937; over a million cubic yards of gravel were washed.

The output of gold in 1938 from placer operations in the Kuskokwim region, other than that by floating connected-bucket dredges, increased greatly. Three of the larger operators, using draglines with portable washing plants and hydraulic mining methods, handled an aggregate of 327,000 cubic yards of gravel with an average recovered gold value of 64 cents to the cubic yard washed.

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Among the large operators making notable production in 1938 were: Strandberg & Sons, Inc., operating on Candle Creek in the Nixon Fork district; the Kow Kow Mining Co., operating on Kow Kow Creek in the Goodnews Bay district; and Kvamme & Co., sluicing on Canyon Creek in the Bethel precinct (Tuluksak-Aniak district).

Although production from lode mines in 1938 showed an increase over 1937, it was small compared with that from all types of placer operations. Among the most important producers—all in the Nixon Fork district—were: Mespelt & Co., operating the Nixon Fork mine; E. M. Whalen, developing and producing from the Whalen mine; and McGowan & Lind, developing and operating the McGowan-Mespelt property.

*Northwestern Alaska region.*—The area of the Kobuk River Valley covering the Kiana and Shungnak districts comprises the Northwestern Alaska region. Mining in this region during 1938 was confined almost entirely to the operation of small placer mines, and Northwestern Alaska was not a large contributor to the total metal output of Alaska.

*Seward Peninsula region.*—In the Seward Peninsula region, which covers all the area of the Seward Peninsula, floating connected-bucket dredges produced 28 percent of the total gold recovered in 1938 from this type of operation in Alaska. There were 22 dredges in operation, an increase of 2 over 1937.

The average value in recovered gold from 11 of the large operators of floating connected-bucket dredges in 1938 was 43 cents to the cubic yard of gravel washed. The length of the open dredging season was 4 to 5½ months, beginning about the middle of May and lasting, in rare instances, to the first of November. Prospecting and preparation of ground for dredging were conducted throughout most of the year.

The United States Smelting, Refining & Mining Co., operating 3 electrically powered Yuba dredges (1 with 103 9-cubic-foot buckets, 1 with 89 9-cubic-foot buckets, and 1 with 78 9-cubic-foot buckets) at Nome, was the largest producer of gold in 1938 from dredge operations in the Seward Peninsula. Active dredging started May 23 and was continued for an average of 156 days per dredge during the rest of the season, each dredge averaging over a million cubic yards of gravel washed during this period. The average grade of material was slightly lower than in 1937. Addition of a fourth dredge is contemplated as soon as ample ground can be prepared for its operation.

The Arctic Circle Exploration Co., operating two dredges in the Fairhaven district during 1938, handled approximately 499,000 cubic yards of gravel averaging 69 cents in value of recovered gold to the cubic yard washed. This company, using two dredges (each equipped with 70 4-cubic-foot buckets), operated for a total of 220 dredge days. A hydraulic plant handling 104,300 cubic yards was in operation 145 days; the average grade of gravel handled was 90 cents in recovered gold value to the cubic yard.

The Bartholomae Oil Corporation and N. B. Tweet & Sons, operating dredges equipped with 31 2¾-cubic-foot buckets and 29 2-cubic-foot buckets, respectively, in the Port Clarence district washed 175,370 cubic yards of gravel in 1938 averaging 53 cents in recovered gold value to the cubic yard. The Bartholomae Oil Corporation

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started operations June 15 and N. B. Tweet & Sons July 15, both ending the season about the middle of October.

Other large producers using floating connected-bucket dredges in 1938 were: The Council Dredging Co., operating in the Council district; the Fox Bar Dredging Co. and the Kougarok Consolidated Placers, operating in the Kougarok district; the Alaska Sunset Mines Corporation, operating in the Nome district; and the Ungalik Syndicate, operating in the Saint Michael district.

Six operators—three in the Kougarok district, one in the Koyukuk district, one in the Nome district, and one in the Fairhaven district—using hydraulic, bulldozing, dragline, and drift mining methods, handled 97,600 cubic yards of gravel in 1938 averaging 91 cents in value of recovered gold to the cubic yard; the average period of operation was May 15 to October 12. The increased use of dragline excavators, slack-line scrapers, and caterpillar bulldozers and the use of portable washing plants have displaced to some extentthe use of hydraulic mining methods in the Seward Peninsula region.

*Southeastern Alaska region.*—Southeastern Alaska, comprising the Chichagof Island, Hyder, Juneau, Ketchikan, and Windham Bay districts, was the most productive lode mining region in Alaska in 1938; it yielded 74 percent of the total lode gold output. There were 17 active or developing mines in operation, but the bulk of the lode production of gold, silver, and lead came from the mining operations of the Alaska Juneau Gold Mining Co. The Twenty-fourth Annual Report of this company for the year ended December 31, 1938 (dated February 28, 1939), says—

> The operating profit, before deductions for depreciation and depletion, of $2,043,059.56 for 1938 was less than that for the preceding year by $372,059.13. This reduction is the product of a small increase in operating costs, a small decrease in yield, and an increase in tons trammed. A small variation in costs and in recovery applied to the total tons for a year amounts to a substantial figure, but these small variations can neither be foreseen nor controlled.
>
> The figures included in Superintendent Metzgar's report, attached hereto, show a gradual increase in production from the Perseverance area, and a gradual decrease in production from the South ore body. This ore body, which has been the chief source of total production for many years, will be less productive hereafter, and an increase in production from the Perseverance area will, in the future, make up for the reduced South ore body output. During the year considerable prospecting was done below the 1,000-ft. level of the North ore body and in that particular portion prospected the bottom of the ore seemed to be definitely indicated at about the 1,200-ft. level. This prospecting work, however, is not yet completed for the entire area of the North ore body.
>
> Development work and stope preparation were continued during the year at about the same rate as in the year 1937. The total tons trammed in the year 1938 was 4,663,880, of which 1,619,570 or 34.73 percent came from the Perseverance section.
>
> In the Perseverance section the total footage of development and preparatory work was 18,409 linear feet of development work and 11,490 square feet of stope cutout which is the equivalent of the work done the previous year; in addition, a large amount of work was done in repairing the shaft and cleaning out and restoring old levels to use. We are now well established in this section and it is a regular and important part of the mine.
>
> The work begun last year on levels Nos. 11, 12 and 13 from the No. 53 winze was continued and ventilating raises from these levels to the levels above were driven.
>
> A series of raises driven from level to level in the western end of the 53 area gives ventilation through to the main level above.
>
> During the year 590,250 pounds of powder were used in blasting powder drifts, or 0.13 pound per ton trammed. The total powder consumption for mining was 0.36 pound per ton trammed as against 0.40 pound in 1937, and 0.31 pound in 1936.

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*Mill.*—The installation of classifying cones and thickeners, mentioned in last year's report, was continued, and each section of the mill now has classifying and thickening. Additional flotation equipment was installed and now the slimes from all sections of the mill are treated by flotation. At the end of the year 2,000 tons of slimes per day were being treated. During the year 450,020 tons of slimes and 180,230 tons of reground middlings were treated in the flotation units.

Experimental work to see what further values may be recovered from the table tailings by flotation at a profit are being continued and a large capacity machine of special design has been ordered.

The fine tailings pumping plant installed in 1937 worked satisfactorily during the year. The increased tonnage handled by the mill worked the original six pumps installed to capacity so one additional pump was installed to take care of time out for repairs.

*Labor.*—The supply of labor was abundant throughout the year, although there was not an overabundance of skilled miners. The labor turnover was small.

Adjustments made during the last months of the year in preparation for conformance with the Wage-Hour Law resulted in an increase of the average wage per day from $6.42 in 1937 to $6.55 in 1938. The over-all cost per man per day this year was $11.22 as against $10.95 in 1937.

*Power plants.*—The regular volume of maintenance work on plants and transmission lines was done. In addition considerable work was done preparatory to rebuilding some of the older portions of the power transmission lines. One section of the Annex Creek line on the mountain will be moved to a location more removed from snowslides.

A power line through Sheep Creek tunnel to Perseverance shaft was completed and transformers were installed. A compressor for installation in the underground station prepared at Perseverance shaft last year has been ordered. This will take care of any additional demand for compressed air in the Perseverance section and make for flexibility of operation.

While there were no specific items of improvement this year that were as large as last the expenditures for maintenance and improvement continued large.

*Gold content of ore from Alaska Juneau mine, 1934–38, and total, 1893–1938*

| Year | Rock to mill from mine (tons) | | Gold (ounce) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Recovery per ton fine-milled | | Losses per ton of tailings | | Content of rock from mine to mill |
| | Ore fine-milled | Coarse tailings rejected | In bullion | In galena concentrates | Fine | Coarse | |
| 1934 | 2,387,138 | 1,915,462 | 0.0503 | 0.0034 | 0.0116 | 0.0082 | 0.0402 |
| 1935 | 2,091,475 | 1,638,185 | .0533 | .0035 | .0108 | .0078 | .0413 |
| 1936 | 2,462,046 | 1,904,754 | .0544 | .0061 | .0089 | .0069 | .0422 |
| 1937 | 2,251,079 | 2,191,681 | .0594 | .0080 | .0116 | .0082 | .0441 |
| 1938 | 2,478,928 | 2,184,952 | .0515 | .0081 | .0090 | .0071 | .0398 |
| Total and average, 1893-1938 | 37,530,918 | 32,586,720 | .0518 | .0118 | .0126 | .0089 | .0449 |

*Gold, silver, and lead recoveries from Alaska Juneau mine, 1893–1938*

| Year | Gold | | Silver | | Lead | | Total value recovered |
|---|---|---|---|---|---|---|---|
| | Fine ounces | Value | Fine ounces | Value | Pounds | Value | |
| 1893-1913 | 34,239.49 | $707,730.15 | (1) | (1) | (1) | (1) | $707,730.15 |
| 1914-33 | 1,656,576.48 | 34,949,995.77 | 1,025,861.17 | $565,592.01 | 24,248,088 | $1,402,705.10 | 36,918,292.88 |
| 1934 | 128,015.26 | 4,465,354.31 | 86,458.27 | 53,842.93 | 1,662,894 | 63,361.73 | 4,582,558.97 |
| 1935 | 118,997.83 | 4,165,784.05 | 77,787.17 | 56,265.16 | 1,455,167 | 59,061.05 | 4,281,110.26 |
| 1936 | 149,235.23 | 5,223,231.16 | 101,590.59 | 78,794.94 | 2,102,594 | 98,594.68 | 5,400,620.78 |
| 1937 | 151,670.64 | 5,308,471.55 | 120,691.21 | 91,528.49 | 1,980,405 | 116,414.16 | 5,516,414.20 |
| 1938 | 148,103.14 | 5,183,542.98 | 121,473.25 | 78,999.04 | 2,152,714 | 101,945.80 | 5,364,487.82 |
| Total | 2,386,838.07 | 60,004,109.97 | 1,533,861.66 | 925,022.57 | 33,601,862 | 1,842,082.52 | 62,771,215.06 |

[1] Lost in tailings.

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The Hirst-Chichagof Mining Co., operating the Hirst-Chichagof mine in the Chichagof Island district, was the second-largest producer of gold in the Southeastern Alaska region in 1938 and shipped the bulk of the dry gold concentrates from this region to Tacoma.

The Alaska Gold & Metals Co., operating in the Ketchikan district in 1938, produced, in connection with its gold and palladium output, the bulk of the copper produced in Southeastern Alaska.

Other producers making a creditable output in 1938 were the Chichagof Mining Co., in the Chichagof Island district, and Nelson & Tift, operating in the Ketchikan district.

*Yukon River Basin region.*—The Yukon River Basin—comprising the Bonnifield, Chandalar, Chisana, Circle, Eagle, Fairbanks, Fort Gibbon, Fortymile, Hot Springs, Iditarod, Innoko, Kantishna, Koyukuk, Marshall, Rampart, Richardson, Ruby, and Tolovana districts—yielded 68 percent of the total gold output from floating connected-bucket dredges in Alaska in 1938; was the largest producer of gold and silver from other types of placer operations; and was third in total output of gold from lode mines.

The bulk of the gold produced in this region in 1938 came from the operation of 19 floating connected-bucket dredges, which washed approximately 12,750,000 cubic yards of gold-bearing gravels, averaging 52 cents in value of recovered gold to the cubic yard. The open dredging season was 4 to 8 months, although prospecting and preparation of ground for future dredging was continuous throughout the year.

The United States Smelting, Refining & Mining Co., operating six floating connected-bucket dredges—two 10-cubic-foot electrically driven dredges, with 111 and 93 buckets, respectively; three electrically driven dredges, with seventy-eight, seventy-eight, and sixty-eight 6-cubic-foot buckets, respectively; and one shallow-digging electrically powered Yuba dredge, with sixty-eight 3-cubic-foot buckets—was the largest producer of gold in this region in 1938. Dredging operations were started March 10; by March 21, five of the large dredges were in operation, continuing without interruption until early in December. The newly constructed shallow-digging dredge was operated from July to November. The six dredges aggregated 1,453 dredge days compared with 1,261 dredge days in the previous season. The yardage of gravels handled was increased substantially, but the grade was slightly lower than in 1937.

The Alluvial Gold, Inc., second-largest producer of gold in this region in 1938, operated a Diesel-powered dredge (seventy-two 4-cubic-foot buckets) on Coal Creek in the Circle district and washed 430,000 cubic yards of gravel during the period June 10 to November 1.

The North American Dredging Co., operating on Otter Creek in the Iditarod district, started operations June 15, 1938, and closed down for the season November 14. The dredge, equipped with sixty 3½-cubic-foot buckets, handled 295,000 cubic yards of gravel during the active season.

The Riley Investment Co., also operating on Otter Creek in the Iditarod district, used a Diesel-powered dredge (fifty-eight 3½-cubic-foot buckets) and handled 311,180 cubic yards of gravel in 1938. Dredging was started June 7 and continued without interruption until November 21.

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Other large producers of gold from floating connected-bucket dredges in 1938 were: In the Circle district—Gold Placers, Inc., using a dredge equipped with sixty 4-cubic-foot buckets; C. J. Berry Dredging Co., using a dredge equipped with fifty-eight 3-cubic-foot buckets; and the Deadwood Mining Co., using a dredge equipped with sixty-five 4-cubic-foot buckets; in the Innoko district—the Holky Dredging Co., operating a 4-cubic-foot dredge on Ganes Creek; in the Fortymile district—North American Mines, Inc. (Jack Wade operations), dredging (seventy 4-cubic-foot buckets) on Jack Wade Creek; and in the Hot Springs district—the American Creek Operating Co., using a Yuba Diesel-powered dredge with 2½-cubic-foot buckets on American Creek.

The Yukon River Basin region produced the bulk of the gold output from placer operations in 1938, excluding that from floating connected-bucket dredges. In most of the region the water supply was ample to insure continuous operations; however, in the Fairbanks district there was a shortage of water until the middle of July when rain relieved the condition. The active working season was 110 to 130 days, beginning early in May. In most of the region, particularly the Fairbanks and Tolovana districts, more extensive use of mechanical equipment increased production of placer gold; increased production in other districts was caused by a longer-than-usual working season. The use of dragline excavators, slack-line scrapers, and caterpillar bulldozers, with auxiliary portable washing plants, was the chief method of mining employed by the large operators.

The recovered tenor of gravel handled by the larger placer operators in 1938 ranged from approximately 46 cents to approximately $1 to the cubic yard throughout the region. In the Bonnifield district two operators hydraulicked 30,000 cubic yards of gravel with an average recovered gold content of 56 cents per cubic yard washed. In the Circle district three operators, using dragline equipment, dragline scrapers, and bulldozers with elevated sluice plants, handled 310,000 cubic yards of gravel with an average recovered gold content of 59 cents. In the Fairbanks district three operators, using draglines and bulldozers with elevated washing plants, and in the Fort Gibbon district one operator, using a dragline with elevated sluices, washed an aggregate of 472,000 cubic yards of gravel with an average recovered gold content of 46 cents. In the Fortymile district the Central Development Syndicate, lessee of the Jack Wade Mining Co., hydraulicked, with the aid of two Diesel caterpillar bulldozers, 90,000 cubic yards of muck and 40,000 cubic yards of gold-bearing gravel; the average recovered gold content was 99 cents. In the Iditarod district three operators, using bulldozers, hydraulic giants, elevated washing plants, and specially constructed sluices, handled 440,000 cubic yards of gold-bearing gravel averaging 46 cents recovered per cubic yard. In the Innoko district two operators, employing dragline equipment supplemented by bulldozers and washing plants, handled 391,000 cubic yards of gravel averaging 49 cents recovered per cubic yard.

A typical operation using mechanical equipment in recovery of placer gold, of which there are many examples in the Yukon River Basin region, is that of the Cripple Creek Mining Co., operating on Cripple Creek in the Innoko district. During the open season 260,000 cubic yards of gravel were handled, with an average recovery in value

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of gold of 55 cents to the cubic yard. Five hydraulic giants were used in stripping the overburden from the paystreak below. A steam-driven dragline exavator was used to bring the pay gravel into the elevated sluice or washing plant. Two pumps were used to furnish adequate water for washing the gravel and to furnish water elsewhere when needed. The company used two caterpillar tractors equipped with bulldozers for general utility work, such as clearing, hauling, etc. The operation began June 20, 1938, and closed down for the season October 20.

Other operators making a notable showing in 1938 and using for the most part dragline excavators and hydraulic equipment as a prime mover of gold-bearing gravel were: The Gold King Mining Co., operating in the Bonnifield district; the Mastadon Mining Co., in the Circle district; Adolph Bock, in the Hot Springs district; the Wolf Creek Mining Co., in the Fairbanks district; and Olson & Co., Vance Hitt, and Peter Miscovich, in the Ruby district. There were more placer operations employing five men or less in the Yukon River Basin region than in any other region in Alaska.

The Yukon River Basin region was the third most productive lode mining region in Alaska during 1938. Most of the lode mines were in the Fairbanks district. The bulk of the gold and silver produced was in the form of bullion sent to local banks and buyers or to the Seattle Assay Office. Some dry gold concentrates were shipped to the Tacoma plant of the American Smelting & Refining Co. Among the larger producers of lode gold were: The Cleary Hill Mines Co., operating the Cleary Hill mine; C. M. Hawkins, operating the Sue and Spaulding mines; and the Hi Yu Mining Co., operating the Hi Yu mine, all in the Fairbanks district.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By T. H. MILLER AND PAUL LUFF

## SUMMARY OUTLINE


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Copper is by far the most important mineral product of Arizona, and the rate of mining operations in the State varies directly with the average sales price of that metal. In 1937 it sold (annual average) for 12.1 cents a pound, and Arizona mines operated at the highest rate since the period 1928–30. The total value of the output of gold, silver, copper, lead, and zinc in 1937 was $90,855,462, the highest recorded since 1929. The sale price of copper started declining in the fall of 1937, and by the end of the year curtailment was in effect in nearly all the large copper-producing districts; it continued throughout 1938, and the total value of the output of the five metals dropped to $58,358,401, or 36 percent compared with 1937, owing to decreased output of copper ore combined with a lower average sales price (9.8 cents a pound) for copper.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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*Mine production of gold, silver, copper, lead, and zinc in Arizona, 1934–38, and total, 1860–1938, in terms of recovered metals*

| Year | Mines producing | | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 747 | 867 | 3,270,242 | 167,024.12 | $5,837,493 | 4,448,474 | $2,875,781 |
| 1935 | 904 | 1,197 | 6,770,050 | 241,754.60 | 8,461,411 | 6,601,280 | 4,744,670 |
| 1936 | 847 | 787 | 13,819,838 | 322,408.20 | 11,284,287 | 8,386,043 | 6,494,990 |
| 1937 | 888 | 376 | 20,976,359 | 332,694.00 | 11,644,290 | 9,422,552 | 7,288,344 |
| 1938 | 885 | 329 | 14,203,164 | 305,043.00 | 10,676,505 | 7,479,153 | 4,835,008 |
| 1860–1938 | | | (1) | 9,247,637.00 | 211,162,450 | 246,290,559 | 184,207,570 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 178,082,213 | $14,246,577 | 6,877,216 | $254,457 | 1,810,279 | $77,842 | $23,292,150 |
| 1935 | 278,029,289 | 23,076,431 | 15,566,100 | 622,644 | 6,673,932 | 293,653 | 37,198,809 |
| 1936 | 422,550,000 | 38,874,600 | 21,376,000 | 983,296 | 7,178,000 | 358,900 | 57,996,073 |
| 1937 | 576,956,000 | 69,811,676 | 24,708,000 | 1,457,772 | 10,052,000 | 653,380 | 90,855,462 |
| 1938 | 421,594,000 | 41,316,212 | 21,142,000 | 972,532 | 11,628,000 | 558,144 | 58,358,401 |
| 1860–1938 | [2] 8,577,198 | 2,646,180,914 | [2] 242,379 | 28,377,844 | [2] 87,643 | 14,023,451 | 3,083,952,229 |

[1] Figures not available. [2] Short tons.

*Gold and silver produced at placer mines in Arizona, 1934–38, in fine ounces, in terms of recovered metals*

| Year | Sluicing [1] | | Drift mining | | Dragline dredges [2] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| 1934 | [3] 4,066.45 | [3] 669 | (3) | (3) | 2,915.81 | 369 | 6,982.26 | 1,038 |
| 1935 | [3] 2,561.47 | [3] 494 | (3) | (3) | 2,595.53 | 338 | 5,157.00 | 832 |
| 1936 | [3] 2,083.69 | [3] 286 | (3) | (3) | 4,403.91 | 604 | 6,487.60 | 890 |
| 1937 | 1,275.00 | 212 | 258.00 | 34 | 2,866.00 | 403 | 4,399.00 | 649 |
| 1938 | 1,624.00 | 213 | 328.00 | 35 | 3,033.00 | 380 | 4,985.00 | 628 |

[1] Includes placer sands treated by dry concentration plants.
[2] Dragline and power-shovel excavators with sluices or special amalgamators.
[3] Figures for sluicing include those for drift mining.

*Gold.*—The output of recoverable gold in Arizona decreased from 332,694 fine ounces in 1937 to 305,043 ounces in 1938, or 8 percent. Gold from siliceous ores (chiefly dry and siliceous gold ore) increased 18,444 ounces in 1938 owing to marked increases in gold ore treated by cyanidation in Mohave, Pinal, and Yavapai Counties, but gold from copper ore decreased 43,509 ounces owing to general curtailment in output of copper ore in all the principal copper-producing districts of the State; the output of gold from zinc-lead ore decreased also. Gold from placers increased slightly; as usual, nearly half of it came from a dragline and floating washing plant in Yavapai County. The Copper Queen (Bisbee) branch of the Phelps Dodge Corporation was the leading gold producer in Arizona in both 1937 and 1938, and the United Verde (Jerome) and New Cornelia (Ajo) branches of the company ranked second and fourth, respectively; there were marked decreases in gold output at each of these three properties, but their

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total represented 39 percent of the State total. Other large gold producers in 1938 included the Goldroad property of the United States Smelting, Refining & Mining Co. in Mohave County, the Mammoth-St. Anthony Limited property in Pinal County, and the Octave unit of the American Smelting & Refining Co. in Yavapai County. Copper

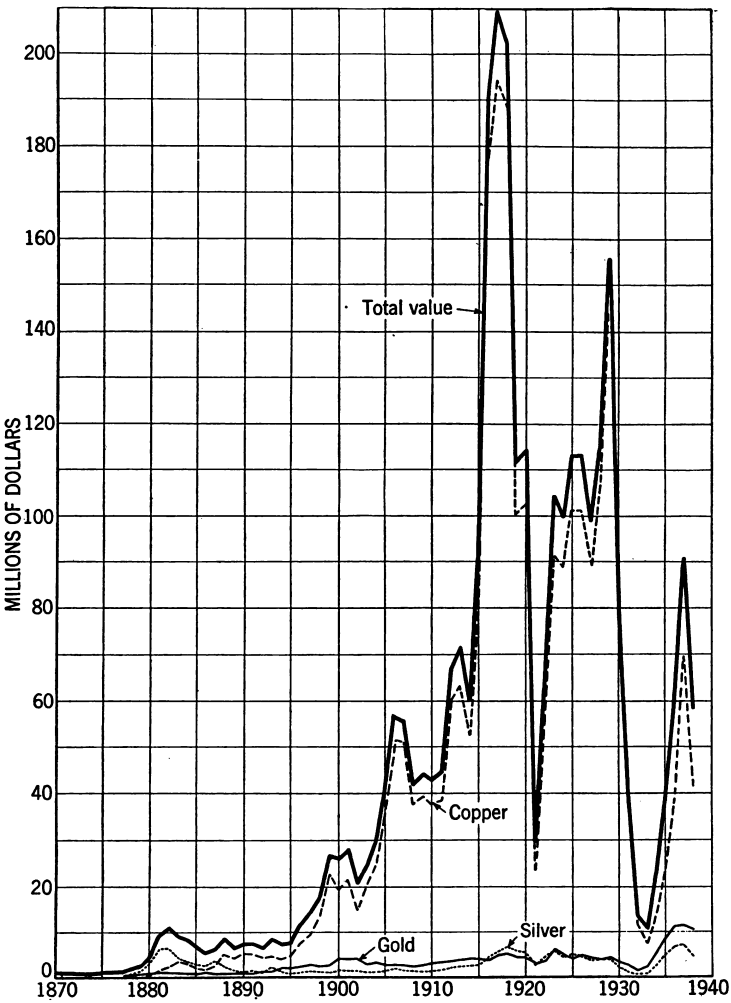


FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1938. The value of lead and zinc has been less than $2,000,000 annually except in a few years.

ore yielded 44 percent of the total gold in 1938 compared with 53 percent in 1937, and siliceous ore yielded 49 and 40 percent, respectively.

*Silver.*—The output of recoverable silver in Arizona decreased 21 percent from 1937 to 1938; nearly all the decrease was in silver from

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copper ore, although silver from lead ore and zinc-lead ore decreased also. Copper ore yielded 61 percent of the silver in 1938 and 68 percent in 1937. The Phelps Dodge Corporation was, as usual, the chief silver producer in Arizona, and in 1938 its three properties (Copper Queen, United Verde, and New Cornelia) produced 51 percent of the State total. Other large silver producers in 1938 included the Montana group of the Eagle-Picher Mining & Smelting Co. in Santa Cruz County, the Ash Peak property of Veta Mines, Inc., in Greenlee County, and the Magma Copper Co. at Superior, Pinal County.

*Copper.*—The mining of copper ore is by far the most important mineral industry in Arizona. In 1937, metals recovered from copper materials were valued at $80,735,047 or 89 percent of the total value of the metal output of the State. Owing to general curtailment of output in the chief copper-producing districts, production of copper ore declined from 19,928,824 tons in 1937 to 13,047,356 tons in 1938, and the value of the metals recovered from copper materials dropped to $48,631,096, or 83 percent of the State total. The total output of copper in Arizona declined 27 percent in quantity and 41 percent in value from 1937, but, despite the marked decrease, Arizona was again the largest copper-producing State. Decreases in copper output (1938 compared with 1937) were noted in five of the seven chief copper districts of Arizona, as follows: The Globe-Miami district, 87,962,902 pounds, owing chiefly to curtailment at the Inspiration property; the Verde (Jerome) district, 26,878,875 pounds; the Ajo (New Cornelia) district, 24,390,066 pounds; the Warren (Bisbee) district, 16,946,064 pounds; and the Mineral Creek (Ray) district, 4,556,588 pounds. Copper from the Copper Mountain district increased 8,652,147 pounds owing to increased output of cement copper from underground leaching operations at the Morenci property, and copper from the Pioneer (Superior) district increased slightly (126,667 pounds). These seven districts contributed more than 98 percent of the total copper output of the State in both 1937 and 1938. Copper materials produced in Arizona in 1938 yielded 418,736,954 pounds of copper, distributed as follows: 10,118,757 tons of copper ore treated by concentration yielded 50 percent, 1,548,387 tons of copper ore shipped for smelting 35 percent, and 1,380,212 tons of copper ore leached and 18,427 tons of cement copper (from mine-water precipitates and underground leaching operations) 15 percent. In 1938 the New Cornelia property of the Phelps Dodge Corporation was again the leading copper producer in Arizona and was followed in order by the Copper Queen and United Verde units of the same company, the Miami Copper Co., the Magma Copper Co., the Inspiration Consolidated Copper Co., the Ray property of the Nevada Consolidated Copper Corporation, and the Morenci property of the Phelps Dodge Corporation.

*Lead and zinc.*—The output of recoverable lead in Arizona in 1938 decreased 14 percent in quantity and 33 percent in value compared with 1937. The output of zinc increased 16 percent in quantity, but it decreased 15 percent in value owing to the lower average sales price. Zinc-lead ore treated by concentration decreased from 212,430 tons in 1937 to 187,694 tons in 1938; 56 percent of the total lead and

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5 percent of the total zinc in 1938 came from zinc-lead ore. Lead nd zinc increased at both the Montana mine at Ruby (Santa Cruz County) and the Tennessee-Schuylkill mine near Chloride (Mohave County), but the output from the "79" mine in the Banner district (Gila County) decreased markedly. Most of the remainder of the ead produced in 1938 came from crude ore shipped for smelting, hiefly from mines in Cochise, Yavapai, and Gila Counties; nearly ll the rest of the zinc came from zinc-copper ore from the Magma ine at Superior treated by flotation in a new section of the copper oncentrator.

## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties, in terms of recovered metals*

1937

| County | Mines producing | | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value |
| ochise | 60 | 4 | 72,140 | $2,524,900 | 3,673,519 | $2,841,467 |
| oconino | 3 | | 4 | 140 | 384 | 297 |
| ila | 59 | 1 | 3,322 | 116,270 | 233,925 | 180,941 |
| raham | 6 | | 6 | 210 | 2,605 | 2,015 |
| reenlee | 11 | 4 | 1,734 | 60,690 | 467,452 | 361,574 |
| aricopa | 53 | 27 | 5,721 | 200,235 | 32,645 | 25,251 |
| ohave | 129 | 11 | 77,898 | 2,726,430 | 640,918 | 495,750 |
| ima | 79 | 16 | 34,401 | 1,204,035 | 466,274 | 360,663 |
| inal | 93 | 1 | 27,465 | 961,275 | 879,479 | 680,277 |
| anta Cruz | 67 | 1 | 6,713 | 234,955 | 735,554 | 568,951 |
| avapai | 261 | 201 | 102,096 | 3,573,360 | 2,285,713 | 1,767,999 |
| uma | 67 | 110 | 1,194 | 41,790 | 4,084 | 3,159 |
| | 888 | 376 | 332,694 | 11,644,290 | 9,422,552 | 7,288,344 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| ochise | 112,205,000 | $13,576,805 | 2,690,000 | $158,710 | | | $19,101,882 |
| oconino | 159,000 | 19,239 | | | | | 19,676 |
| ila | 178,603,000 | 21,610,963 | 2,461,000 | 145,199 | 1,031,000 | $67,015 | 22,120,388 |
| raham | 6,000 | 726 | 125,000 | 7,375 | | | 10,326 |
| reenlee | 13,659,000 | 1,652,739 | 17,000 | 1,003 | | | 2,076,006 |
| aricopa | 332,000 | 40,172 | 148,000 | 8,732 | | | 274,390 |
| ohave | 463,000 | 56,023 | 5,055,000 | 298,245 | 3,443,000 | 223,795 | 3,800,243 |
| ima | 111,279,000 | 13,464,759 | 240,000 | 14,160 | | | 15,043,617 |
| inal | 71,690,000 | 8,674,490 | 2,096,000 | 123,664 | | | 10,439,706 |
| anta Cruz | 597,000 | 72,237 | 9,798,000 | 578,082 | 5,400,000 | 351,000 | 1,805,225 |
| avapai | 86,805,000 | 10,503,405 | 2,042,000 | 120,478 | 178,000 | 11,570 | 15,976,812 |
| uma | 1,158,000 | 140,118 | 36,000 | 2,124 | | | 187,191 |
| | 576,956,000 | 69,811,676 | 24,708,000 | 1,457,772 | 10,052,000 | 653,380 | 90,855,462 |

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*Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, b counties, in terms of recovered metals*—Continued

1938

| County | Mines producing | | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value |
| Cochise | 50 | 13 | 56,356 | $1,972,460 | 2,720,172 | $1,758,49 |
| Coconino | 5 | | 3 | 105 | 263 | 17 |
| Gila | 64 | 5 | 2,636 | 92,260 | 73,325 | 47,40 |
| Graham | 11 | | 20 | 700 | 9,620 | 6,21 |
| Greenlee | 8 | 7 | 1,991 | 69,685 | 532,555 | 344,27 |
| Maricopa | 42 | 23 | 3,657 | 127,995 | 11,569 | 7,47 |
| Mohave | 191 | 15 | 79,723 | 2,790,305 | 669,933 | 433,08 |
| Pima | 65 | 11 | 24,982 | 874,370 | 318,483 | 205,88 |
| Pinal | 71 | 2 | 35,877 | 1,255,695 | 877,406 | 567,21 |
| Santa Cruz | 57 | 2 | 6,356 | 222,460 | 610,799 | 394,86 |
| Yavapai | 275 | 170 | 91,473 | 3,201,555 | 1,645,824 | 1,063,96 |
| Yuma | 46 | 81 | 1,969 | 68,915 | 9,204 | 5,95 |
| | 885 | 329 | 305,043 | 10,676,505 | 7,479,153 | 4,835,00 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Cochise | 95,084,959 | $9,318,326 | 829,478 | $38,156 | | | $13,087,43 |
| Coconino | 110,551 | 10,834 | | | | | 11,10 |
| Gila | 89,418,337 | 8,762,997 | 625,000 | 28,750 | 47,000 | $2,256 | 8,933,66 |
| Graham | 22,694 | 2,224 | 310,217 | 14,270 | | | 23,41 |
| Greenlee | 22,310,694 | 2,186,448 | 20,739 | 954 | | | 2,601,36 |
| Maricopa | 225,500 | 22,099 | 9,717 | 447 | | | 158,02 |
| Mohave | 330,112 | 32,351 | 4,025,152 | 185,157 | 3,319,812 | 159,351 | 3,600,25 |
| Pima | 86,959,439 | 8,522,025 | 41,218 | 1,896 | | | 9,604,17 |
| Pinal | 67,713,949 | 6,635,967 | 4,181,174 | 192,334 | 1,650,000 | 79,200 | 8,730,40 |
| Santa Cruz | 522,265 | 51,182 | 8,645,022 | 397,671 | 6,530,000 | 313,440 | 1,379,61 |
| Yavapai | 58,874,939 | 5,769,744 | 2,410,218 | 110,870 | 81,188 | 3,897 | 10,150,03 |
| Yuma | 20,561 | 2,015 | 44,065 | 2,027 | | | 78,90 |
| | 421,594,000 | 41,316,212 | 21,142,000 | 972,532 | 11,628,000 | 558,144 | 58,358,40 |

*Gold and silver produced at lode mines in Arizona, 1937–38, by counties, in term of recovered metals*

| County | Ore sold or treated | Gold | Silver |
|---|---|---|---|
| 1937 | *Short tons* | *Fine ounces* | *Fine ounces* |
| Cochise | 1,104,738 | 72,058 | 3,673,51 |
| Coconino | 823 | 4 | 38 |
| Gila | 9,779,189 | 3,316 | 233,92 |
| Graham | 467 | 6 | 2,60 |
| Greenlee | 52,884 | 1,720 | 467,44 |
| Maricopa | 87,084 | 5,638 | 32,62 |
| Mohave | 408,808 | 77,779 | 640,88 |
| Pima | 6,094,651 | 34,338 | 466,26 |
| Pinal | 1,699,399 | 27,432 | 879,47 |
| Santa Cruz | 148,010 | 6,711 | 735,55 |
| Yavapai | 1,579,696 | 98,530 | 2,285,20 |
| Yuma | 20,610 | 763 | 4,03 |
| | 20,976,359 | 328,295 | 9,421,90 |
| 1938 | | | |
| Cochise | 931,572 | 56,276 | 2,720,15 |
| Coconino | 447 | 3 | 26 |
| Gila | 4,834,688 | 2,617 | 73,32 |
| Graham | 914 | 20 | 9,62 |
| Greenlee | 70,791 | 1,963 | 532,55 |
| Maricopa | 28,675 | 3,562 | 11,55 |
| Mohave | 445,253 | 79,637 | 669,91 |
| Pima | 4,994,856 | 24,926 | 318,48 |
| Pinal | 1,710,040 | 35,873 | 877,40 |
| Santa Cruz | 134,776 | 6,354 | 610,79 |
| Yavapai | 1,049,615 | 87,550 | 1,645,34 |
| Yuma | 1,537 | 1,277 | 9,10 |
| | 14,203,164 | 300,058 | 7,478,52 |

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*Gold and silver produced at placer mines in Arizona, 1937–38, by counties, in fine ounces, in terms of recovered metals*

| County | Sluicing[1] | | Drift mining | | Dragline dredges[2] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| 1937 | | | | | | | | |
| Cochise | 6 | | | | 76 | 9 | 82 | 9 |
| Gila | 6 | | | | | | 6 | |
| Greenlee | 14 | 4 | | | | | 14 | 4 |
| Maricopa | 62 | 13 | 21 | 5 | | | 83 | 18 |
| Mohave | 42 | 17 | | | 77 | 18 | 119 | 35 |
| Pima | 31 | 4 | 32 | 5 | | | 63 | 9 |
| Pinal | 33 | 9 | | | | | 33 | 9 |
| Santa Cruz | 2 | | | | | | 2 | |
| Yavapai | 892 | 142 | | | 2,674 | 370 | 3,566 | 512 |
| Yuma | 187 | 23 | 205 | 24 | 39 | 6 | 431 | 53 |
| | 1,275 | 212 | 258 | 34 | 2,866 | 403 | 4,399 | 649 |
| 1938 | | | | | | | | |
| Cochise | 31 | 2 | | | 49 | 12 | 80 | 14 |
| Gila | 19 | | | | | | 19 | |
| Greenlee | 26 | 3 | 2 | | | | 28 | 3 |
| Maricopa | 95 | 17 | | | | | 95 | 17 |
| Mohave | 86 | 17 | | | | | 86 | 17 |
| Pima | | | 56 | 3 | | | 56 | 3 |
| Pinal | 4 | | | | | | 4 | |
| Santa Cruz | 2 | | | | | | 2 | |
| Yavapai | 939 | 110 | | | 2,984 | 368 | 3,923 | 478 |
| Yuma | 422 | 64 | 270 | 32 | | | 692 | 96 |
| | 1,624 | 213 | 328 | 35 | 3,033 | 380 | 4,985 | 628 |

[1] Includes placer sands treated by dry concentration plants.
[2] Dragline and power-shovel excavators with sluices or special amalgamators.

## MINING INDUSTRY

There were large increases in output of copper in 1937 from mines in all seven (Ajo, Bisbee, Globe-Miami, Jerome, Morenci, Ray-Hayden, and Superior) of the principal copper-producing districts in Arizona, but curtailment during 1938 brought about large decreases in yield of copper from all of these districts except Morenci and Superior. The Phelps Dodge Corporation reduced its rate of production at Ajo, Bisbee, and Jerome, but the output of copper from underground leaching operations at Morenci increased; development and test work on the new Morenci ore body continued during both years, and plant construction was expected to begin in 1939. The Magma Copper Co. operated the mine, mill, and smelter at Superior at a normal rate during both 1937 and 1938; in 1938, in addition to copper ore, the company started treatment of zinc-copper ore in a new flotation section of the mill. The Ray property of the Nevada Consolidated Copper Corporation was closed during the summer months, and the output of copper declined. Production at both the Miami and Inspiration properties in the Globe-Miami district decreased in 1938; the Miami Copper Co. continued to treat copper ore by combined leaching and flotation throughout both years, but the Inspiration Consolidated Copper Co. discontinued the dual treatment process January 12, 1938, and straight leaching was used on the ore mined during the remainder of the year. Copper smelting plants at Douglas, Hayden, Clarkdale, Miami, Morenci, and Superior were operated continuously during 1938 but at a much lower rate than in 1937.

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The average sales prices of lead and zinc declined in 1938, and th output of zinc-lead ore decreased; however, the mining of dry an siliceous ores (chiefly gold ore) continued to increase, and 928,707 ton were produced in 1938 compared with 804,949 tons in 1937.

## ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volum on Gold and Silver.

*Ore sold or treated in Arizona, 1937–38, with content in terms of recovered meta*

| Source | Mines producing | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | |
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 431 | 615,614 | 117,464 | 429,535 | 803,297 | 2,192,204 | |
| Dry and siliceous gold-silver ore | 29 | 72,888 | 10,861 | 397,595 | 94,397 | 1,419,642 | 18,8 |
| Dry and siliceous silver ore | 109 | 116,447 | 3,602 | 1,098,141 | 364,043 | 314,541 | |
| | [1] 542 | 804,949 | 131,927 | 1,925,271 | 1,261,737 | 3,926,387 | 18,8 |
| Copper ore | 208 | 19,928,824 | 176,918 | 6,439,903 | [2] 574,869,731 | 40,939 | |
| Lead ore | 145 | 29,969 | 2,346 | 224,839 | 179,831 | 6,914,551 | |
| Lead-copper ore | 7 | 59 | 4 | 773 | 5,216 | 22,897 | |
| Zinc ore | 1 | 91 | 2 | 90 | 505 | 1,000 | 34,1 |
| Zinc-lead ore | 8 | 212,467 | 17,098 | 831,027 | 638,980 | 13,802,226 | 9,999,0 |
| Total, lode mines | [1] 888 | 20,976,359 | 328,295 | 9,421,903 | [2] 576,956,000 | 24,708,000 | 10,052,0 |
| Total, placers | 376 | | 4,399 | 649 | | | |
| | 1,264 | 20,976,359 | 332,694 | 9,422,552 | [2] 576,956,000 | 24,708,000 | 10,052,0 |
| 1938 | | | | | | | |
| Dry and siliceous gold ore | 554 | 698,687 | 129,177 | 330,081 | 567,068 | 4,655,111 | |
| Dry and siliceous gold-silver ore | 73 | 137,062 | 19,011 | 875,415 | 362,559 | 2,433,415 | 81,1 |
| Dry and siliceous silver ore | 92 | 92,958 | 2,183 | 941,637 | 83,518 | 63,511 | |
| | [1] 714 | 928,707 | 150,371 | 2,147,133 | 1,013,145 | 7,152,037 | 81,1 |
| Copper ore | 97 | 13,047,356 | 133,409 | 4,525,435 | [3] 418,736,954 | 559 | |
| Lead ore | 96 | 6,072 | 1,048 | 87,700 | 56,776 | 2,031,838 | |
| Lead-copper ore | 6 | 201 | 20 | 2,724 | 9,403 | 31,587 | |
| Zinc ore | 1 | 160 | 33 | 724 | 1,000 | 2,850 | 41,3 |
| Zinc-copper ore | 1 | 32,974 | 372 | 63,845 | 1,189,500 | | 1,650,0 |
| Zinc-lead ore | 7 | 187,694 | 14,805 | 650,964 | 587,222 | 11,923,129 | 9,855,5 |
| Total, lode mines | [1] 885 | 14,203,164 | 300,058 | 7,478,525 | [3] 421,594,000 | 21,142,000 | 11,628,0 |
| Total, placers | 329 | | 4,985 | 628 | | | |
| | 1,214 | 14,203,164 | 305,043 | 7,479,153 | [3] 421,594,000 | 21,142,000 | 11,628,0 |

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 95,561,691 pounds recovered from ore leached and mine-water precipitates.
[3] Includes 61,739,674 pounds recovered from ore leached and mine-water precipitates.

## METALLURGIC INDUSTRY

The output of ore and old tailings of all classes in Arizona decrease from 20,976,359 tons in 1937 to 14,203,164 tons in 1938.

Gold ore treated at amalgamation mills decreased from 46,654 ton in 1937 to 11,177 tons in 1938, but siliceous material treated at cyani dation plants increased markedly—from 385,086 to 605,367 tons There were substantial increases in ore treated by cyanidation i Mohave, Pinal, and Yavapai Counties.

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Ore and old tailings treated at concentration plants decreased from 8,203,790 tons in 1937 to 10,546,807 tons in 1938; most of the decrease was in copper ore. Ore concentrated in Arizona in 1938 comprised 30,907 tons of gold ore, 110,632 tons of gold-silver ore, 65,435 tons of silver ore, 10,118,757 tons of copper ore (compared with 17,727,331 tons in 1937), 116 tons of lead ore, 132 tons of lead-copper ore, 60 tons of zinc ore, 32,974 tons of zinc-copper ore, and 187,694 tons of zinc-lead ore. Copper ore from the Miami property and a small part of the copper ore from the Inspiration property, both near Miami, were treated by a combination of leaching and flotation, and these data are included with ore treated at straight concentration plants. Most of the ore from the Inspiration mine in 1938 was treated by straight leaching, the dual treatment having been terminated January 12, 1938.

The following tables give details of the treatment of all ores produced in Arizona in 1937 and 1938.

*Mine production of metals in Arizona, 1937–38, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| 1937 | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore and old tailings amalgamated | 46,654 | 5,167 | 2,393 | | | |
| Ore and old tailings cyanided | 385,086 | 58,317 | 90,012 | | | |
| Concentrates smelted | 669,320 | 110,428 | 3,064,430 | 292,507,433 | 17,694,009 | 10,039,000 |
| Ore smelted | 2,340,829 | 154,359 | 6,264,011 | 188,886,876 | 7,013,991 | 13,000 |
| Copper precipitates smelted | 17,010 | 24 | 1,057 | [1] 24,683,500 | | |
| Electrolytic copper | [2] | | | [2] 70,878,191 | | |
| Placer | | 4,399 | 649 | | | |
| | | 332,694 | 9,422,552 | 576,956,000 | 24,708,000 | 10,052,000 |
| 1938 | | | | | | |
| Ore and old tailings amalgamated | 11,177 | 1,796 | 575 | | | |
| Ore and old tailings cyanided | 605,367 | 73,856 | 134,682 | | | |
| Concentrates smelted | 547,519 | 106,505 | 2,817,824 | 213,197,084 | 17,889,480 | 11,628,000 |
| Ore smelted | 1,659,601 | 117,901 | 4,525,444 | 146,657,242 | 3,252,520 | |
| Copper precipitates smelted | 18,427 | | | [3] 30,142,472 | | |
| Electrolytic copper | [4] 1,380,212 | | | 31,597,202 | | |
| Placer | | 4,985 | 628 | | | |
| | | 305,043 | 7,479,153 | 421,594,000 | 21,142,000 | 11,628,000 |

[1] Distributed as follows: Cochise County, 4,013,500 pounds; Greenlee County, 13,615,000 pounds; Pinal County, 6,300,000 pounds; and Yavapai County, 755,000 pounds.
[2] The copper is from 5,122,636 tons of copper ore treated by leaching and concentration at 1 plant in Gila County; the ore is included in that sent to straight concentration plants. See second table following.
[3] Distributed as follows: Cochise County, 1,500,000 pounds; Greenlee County, 22,281,450 pounds; Pinal County, 5,580,000 pounds; and Yavapai County, 781,022 pounds.
[4] Copper ore treated by straight leaching at 1 plant in Gila County.

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*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Arizona, 1937–38, by types of mills and by counties in terms of recovered metals*

AMALGAMATION MILLS

| County | Material treated | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| 1937 | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Gila | 61 | 51 | 32 | 1 | 1 | | | |
| Graham | 150 | 3 | | | | | | |
| Maricopa | 691 | 67 | 18 | 3 | 9 | 4 | 48 | 40 |
| Mohave | 41,182 | 4,294 | 2,102 | 233 | 2,278 | 5,894 | 620 | 198 |
| Pima | 330 | 119 | 49 | 1 | 7 | 5 | | |
| Pinal | 5 | 5 | 2 | 1 | 1 | | | |
| Santa Cruz | 50 | 41 | 26 | | | | | |
| Yavapai | 3,793 | 381 | 110 | 95 | 364 | 461 | 3,557 | 4,243 |
| Yuma | 392 | 206 | 54 | 4 | 4 | | | |
| | 46,654 | 5,167 | 2,393 | 338 | 2,664 | 6,364 | 4,225 | 4,481 |
| 1938 | | | | | | | | |
| Cochise | 109 | 28 | 5 | | | | | |
| Gila | 135 | 39 | 10 | | | | | |
| Maricopa | 4,683 | 344 | 111 | 129 | 166 | 115 | 355 | |
| Mohave | 3,213 | 323 | 127 | 61 | 316 | 218 | 48 | |
| Pima | 309 | 96 | 40 | 11 | 22 | 22 | | |
| Pinal | 70 | 11 | 16 | 1 | 2 | 3 | | |
| Santa Cruz | 13 | 9 | 4 | | | | | |
| Yavapai | 2,210 | 694 | 197 | 41 | 166 | 139 | 1,107 | 2,000 |
| Yuma | 435 | 252 | 65 | | | | | |
| | 11,177 | 1,796 | 575 | 243 | 672 | 497 | 1,510 | 2,000 |

CYANIDATION MILLS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | |
| Cochise | 1,700 | 11 | 912 | | | | | |
| Gila | 2 | | 190 | | | | | |
| Maricopa | 21,000 | 767 | 1,570 | | | | | |
| Mohave | 245,952 | 55,301 | 81,991 | | | | | |
| Pima | 250 | 31 | 12 | | | | | |
| Pinal | 87,983 | 796 | 3,930 | 2,001 | 10,867 | 20,975 | | 1,575,668 |
| Yavapai | 28,190 | 1,389 | 1,403 | 488 | 7,139 | 7,912 | 8,602 | 80,124 |
| Yuma | 9 | 22 | 4 | | | | | |
| | 385,086 | 58,317 | 90,012 | 2,489 | 18,006 | 28,887 | 8,602 | 1,655,792 |
| 1938 | | | | | | | | |
| Cochise | 69 | | 195 | | | | | |
| Maricopa | 11,675 | 429 | 699 | | | | | |
| Mohave | 330,676 | 63,571 | 114,078 | | | | | |
| Pinal | 165,465 | 2,169 | 6,229 | 4,190 | 19,235 | 28,536 | | 3,822,391 |
| Yavapai | 97,482 | 7,687 | 13,531 | 585 | 8,076 | 6,974 | 7,013 | 39,000 |
| | 605,367 | 73,856 | 134,682 | 4,775 | 27,311 | 35,510 | 7,013 | 3,861,391 |
| Grand total: 1937 | 431,740 | 63,484 | 92,405 | 2,827 | 20,670 | 35,251 | 12,827 | 1,660,273 |
| 1938 | 616,544 | 75,652 | 135,257 | 5,018 | 27,983 | 36,007 | 8,523 | 3,863,391 |

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*Mine production of metals from concentrating mills in Arizona, 1937–38, by counties, in terms of recovered metals*

| County | Material treated | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|
| | | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| 1937 | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Cochise | 5,771 | 405 | 175 | 22,226 | 1,546 | 163,055 | |
| Gila | [1] 9,735,330 | 137,783 | 2,114 | 156,211 | [1] 105,583,994 | 1,386,850 | 1,018,000 |
| Greenlee | 42,740 | 454 | 1,253 | 352,626 | 5,745 | 11,780 | |
| Maricopa | 50,125 | 1,013 | 1,400 | 4,605 | 28,810 | 430 | |
| Mohave | 115,109 | 16,857 | 13,842 | 489,853 | 322,918 | 4,854,733 | 3,443,000 |
| Pima | 6,091,177 | 183,524 | 33,823 | 442,642 | 111,176,260 | 10,571 | |
| Pinal | 1,528,806 | 172,190 | 7,976 | 379,416 | 55,182,061 | 295,355 | |
| Santa Cruz | 140,102 | 14,657 | 6,541 | 640,263 | 489,563 | 7,729,116 | 5,400,000 |
| Yavapai | 475,455 | 137,239 | 22,616 | 539,469 | 18,604,613 | 1,568,812 | 178,000 |
| Yuma | 19,175 | 2,371 | 18 | 1,868 | 1,099,096 | 13,034 | |
| | [1] 18,203,790 | 666,493 | 89,758 | 3,029,179 | [1] 292,494,606 | 16,033,736 | 10,039,000 |
| 1938 | | | | | | | |
| Cochise | 1,630 | 86 | 237 | 2,639 | 2,067 | 18,815 | |
| Gila | 3,443,747 | 62,315 | 1,016 | 49,816 | 57,399,448 | 73,500 | 47,000 |
| Greenlee | 64,709 | 721 | 1,518 | 458,426 | 7,718 | 18,500 | |
| Maricopa | 1,975 | 57 | 75 | 230 | 1,553 | | |
| Mohave | 107,232 | 16,348 | 13,613 | 503,429 | 284,688 | 3,870,269 | 3,319,812 |
| Pima | 4,992,623 | 149,420 | 24,434 | 294,211 | 86,884,000 | 6,269 | |
| Pinal | 1,457,511 | 173,461 | 7,565 | 352,159 | 52,378,934 | 28,870 | 1,650,000 |
| Santa Cruz | 132,750 | 15,512 | 6,063 | 549,370 | 485,003 | 8,299,993 | 6,530,000 |
| Yavapai | 344,630 | 124,581 | 24,001 | 571,537 | 15,745,150 | 1,709,873 | 81,188 |
| | 10,546,807 | 542,501 | 78,522 | 2,781,817 | 213,188,561 | 14,026,089 | 11,628,000 |

[1] Ore yielded also 70,878,191 pounds of copper by leaching. See first table under "Metallurgic Industry."

*Gross metal content of concentrates produced from ore mined in Arizona, 1937–38, by classes of concentrates*

| Class of concentrates | Concentrates | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| 1937 | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 3,463 | 7,466 | 19,987 | 73,007 | 43,329 | |
| Dry gold-silver | 1,377 | 1,939 | 150,903 | 26,700 | 113,200 | |
| Dry silver | 2,942 | 2,041 | 468,890 | 141,654 | 24,111 | |
| Copper | 620,553 | 53,402 | 1,251,461 | 301,226,472 | 4,113 | |
| Lead | 30,002 | 44,074 | 1,033,747 | 836,939 | 17,809,912 | 2,671,504 |
| Lead-copper | 445 | 219 | 62,775 | 53,000 | 130,089 | |
| Zinc | 10,509 | 1,273 | 75,601 | 105,875 | 625,591 | 11,144,475 |
| Iron (from zinc-lead ore) | 29 | 14 | 1,066 | 93 | 1,626 | 1,304 |
| | 669,320 | 110,428 | 3,064,430 | 302,463,740 | 18,751,971 | 13,817,283 |
| 1938 | | | | | | |
| Dry gold | 7,512 | 12,325 | 61,208 | 54,446 | 183,192 | |
| Dry gold-silver | 4,393 | 3,216 | 355,170 | 115,896 | 195,735 | |
| Dry silver | 741 | 1,526 | 465,186 | 8,185 | 27,085 | |
| Copper | 495,087 | 44,426 | 973,511 | 219,149,215 | 50,000 | 2,278,250 |
| Lead | 27,659 | 43,792 | 875,996 | 749,952 | 17,881,441 | 2,495,368 |
| Lead-copper | 22 | 4 | 492 | 5,113 | 14,590 | |
| Zinc | 12,105 | 1,216 | 86,261 | 221,906 | 521,793 | 12,831,329 |
| | 547,519 | 106,505 | 2,817,824 | 220,304,713 | 18,873,836 | 17,604,947 |

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*Mine production of metals from Arizona concentrates shipped to smelters, 1937–38, i terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| 1937 | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Cochise | 405 | 175 | 22,226 | 1,546 | 163,055 | |
| Gila | 137,784 | 2,115 | 156,211 | 105,583,994 | 1,386,850 | 1,018,00 |
| Greenlee | 454 | 1,253 | 352,626 | 5,745 | 11,780 | |
| Maricopa | 1,016 | 1,409 | 4,609 | 28,858 | 470 | |
| Mohave | 17,090 | 16,120 | 495,747 | 323,538 | 4,854,931 | 3,443,00 |
| Pima | 183,525 | 33,830 | 442,647 | 111,176,260 | 10,571 | |
| Pinal | 174,192 | 18,844 | 400,391 | 55,182,061 | 1,871,023 | |
| Santa Cruz | 14,657 | 6,541 | 640,263 | 489,563 | 7,729,116 | 5,400,00 |
| Yavapai | 137,822 | 30,119 | 547,842 | 18,616,772 | 1,653,179 | 178,00 |
| Yuma | 2,375 | 22 | 1,868 | 1,099,096 | 13,034 | |
| | 669,320 | 110,428 | 3,064,430 | 292,507,433 | 17,694,009 | 10,039,00 |
| 1938 | | | | | | |
| Cochise | 86 | 237 | 2,639 | 2,067 | 18,815 | |
| Gila | 62,315 | 1,016 | 49,816 | 57,399,448 | 73,500 | 47,00 |
| Greenlee | 721 | 1,518 | 458,426 | 7,718 | 18,500 | |
| Maricopa | 186 | 241 | 345 | 1,908 | | |
| Mohave | 16,409 | 13,929 | 503,647 | 284,736 | 3,870,269 | 3,319,81 |
| Pima | 149,431 | 24,456 | 294,233 | 86,884,000 | 6,269 | |
| Pinal | 177,652 | 26,802 | 380,698 | 52,378,934 | 3,851,261 | 1,650,00 |
| Santa Cruz | 15,512 | 6,063 | 549,370 | 485,003 | 8,299,993 | 6,530,00 |
| Yavapai | 125,207 | 32,243 | 578,650 | 15,753,270 | 1,750,873 | 81,18 |
| | 547,519 | 106,505 | 2,817,824 | 213,197,084 | 17,889,480 | 11,628,00 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| 1937 | | | | | | |
| Dry gold | 3,463 | 7,466 | 19,987 | 68,373 | 33,916 | |
| Dry gold-silver | 1,377 | 1,939 | 150,903 | 17,126 | 108,478 | |
| Dry silver | 2,942 | 2,041 | 468,890 | 135,881 | 16,316 | |
| Copper | 620,553 | 53,402 | 1,251,461 | 291,530,051 | 3,510 | |
| Lead | 30,002 | 44,074 | 1,033,747 | 644,805 | 16,886,050 | |
| Lead-copper | 445 | 219 | 62,775 | 40,000 | 124,000 | |
| Zinc | 10,509 | 1,273 | 75,601 | 71,108 | 520,744 | 10,039,000 |
| Iron (from zinc-lead ore) | 29 | 14 | 1,066 | 89 | 995 | |
| | 669,320 | 110,428 | 3,064,430 | 292,507,433 | 17,694,009 | 10,039,000 |
| 1938 | | | | | | |
| Dry gold | 7,512 | 12,325 | 61,208 | 50,917 | 138,640 | |
| Dry gold-silver | 4,393 | 3,216 | 355,170 | 107,580 | 176,997 | |
| Dry silver | 741 | 1,526 | 465,186 | 7,774 | 19,090 | |
| Copper | 495,087 | 44,426 | 973,511 | 212,290,573 | 45,000 | |
| Lead | 27,659 | 43,792 | 875,996 | 582,980 | 17,047,080 | |
| Lead-copper | 22 | 4 | 492 | 4,100 | 13,870 | |
| Zinc | 12,105 | 1,216 | 86,261 | 153,160 | 448,803 | 11,628,000 |
| | 547,519 | 106,505 | 2,817,824 | 213,197,084 | 17,889,480 | 11,628,000 |

*Gross metal content of Arizona crude ore shipped to smelters, 1937–38, by classes of ore*

| Class of ore | Ore | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| 1937 | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 69,376 | 25,269 | 211,452 | 732,810 | 337,839 | |
| Dry and siliceous gold-silver | 6,809 | 1,808 | 101,732 | 25,154 | 203,038 | |
| Dry and siliceous silver | 39,698 | 1,203 | 554,296 | 192,117 | 186,073 | |
| Copper | 2,201,293 | 123,762 | 5,190,900 | 200,742,624 | 62,825 | |
| Lead | 23,557 | 2,313 | 204,858 | 230,311 | 6,843,867 | |
| Lead-copper | 59 | 4 | 773 | 6,221 | 24,711 | |
| Zinc-lead | 37 | | | | 10,588 | 15,211 |
| 1938 | 2,340,829 | 154,359 | 6,264,011 | 201,929,237 | 7,668,941 | 15,211 |
| Dry and siliceous gold | 60,409 | 22,393 | 136,432 | 531,142 | 777,267 | |
| Dry and siliceous gold-silver | 17,386 | 4,319 | 186,915 | 124,522 | 646,223 | |
| Dry and siliceous silver | 27,394 | 656 | 475,072 | 80,381 | 51,296 | |
| Copper | 1,548,387 | 89,649 | 3,637,677 | 155,760,200 | 730 | |
| Lead | 5,956 | 868 | 87,116 | 73,149 | 2,108,657 | |
| Lead-copper | 69 | 16 | 2,232 | 6,379 | 18,871 | |
| | 1,659,601 | 117,901 | 4,525,444 | 156,575,773 | 3,603,044 | |

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*Mine production of metals from Arizona crude ore shipped to smelters, 1937–38, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| 1937 | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Cochise | 1,097,267 | 71,872 | 3,650,372 | 108,189,954 | 2,526,945 | |
| Coconino | 823 | 4 | 384 | 159,000 | | |
| Gila | 43,796 | 1,150 | 77,492 | 2,140,815 | 1,074,150 | 13,000 |
| Graham | 317 | 3 | 2,605 | 6,000 | 125,000 | |
| Greenlee | 10,144 | 467 | 114,822 | 38,255 | 5,220 | |
| Maricopa | 15,268 | 3,395 | 26,430 | 303,142 | 147,530 | |
| Mohave | 6,565 | 2,064 | 61,043 | 139,462 | 200,069 | |
| Pima | 2,894 | 358 | 23,557 | 102,740 | 229,429 | |
| Pinal | 82,605 | 7,763 | 474,090 | 10,207,939 | 224,977 | |
| Santa Cruz | 7,858 | 129 | 95,265 | 107,437 | 2,068,884 | |
| Yavapai | 1,072,258 | 66,641 | 1,735,846 | 67,433,228 | 388,821 | |
| Yuma | 1,034 | 513 | 2,105 | 58,904 | 22,966 | |
| | 2,340,829 | 154,359 | 6,264,011 | 188,886,876 | 7,013,991 | 13,000 |
| 1938 | | | | | | |
| Cochise | 929,764 | 56,011 | 2,717,319 | 93,582,892 | 810,663 | |
| Coconino | 447 | 3 | 263 | 110,551 | | |
| Gila | 10,594 | 1,562 | 23,499 | 421,687 | 551,500 | |
| Graham | 914 | 20 | 9,620 | 22,694 | 310,217 | |
| Greenlee | 6,082 | 445 | 74,126 | 21,526 | 2,239 | |
| Maricopa | 10,342 | 2,548 | 10,397 | 223,592 | 9,717 | |
| Mohave | 4,132 | 1,814 | 52,114 | 45,376 | 154,883 | |
| Pima | 1,924 | 374 | 24,207 | 75,439 | 34,949 | |
| Pinal | 86,994 | 6,891 | 490,463 | 9,755,015 | 329,913 | |
| Santa Cruz | 2,013 | 282 | 61,425 | 37,262 | 345,029 | |
| Yavapai | 605,293 | 46,926 | 1,052,968 | 42,340,647 | 659,345 | |
| Yuma | 1,102 | 1,025 | 9,043 | 20,561 | 44,065 | |
| | 1,659,601 | 117,901 | 4,525,444 | 146,657,242 | 3,252,520 | |

BY CLASSES OF ORE

| | | | | | | |
|---|---|---|---|---|---|---|
| 1937 | | | | | | |
| Dry and siliceous gold | 69,376 | 25,269 | 211,452 | 703,017 | 221,670 | |
| Dry and siliceous gold-silver | 6,809 | 1,808 | 101,732 | 24,221 | 132,348 | |
| Dry and siliceous silver | 39,698 | 1,203 | 554,296 | 184,548 | 127,871 | |
| Copper | 2,201,293 | 123,762 | 5,190,900 | 187,792,169 | 40,099 | |
| Lead | 23,557 | 2,313 | 204,858 | 177,705 | 6,460,106 | |
| Lead-copper | 59 | 4 | 773 | 5,216 | 22,897 | |
| Zinc-lead | 37 | | | | 9,000 | 13,000 |
| | 2,340,829 | 154,359 | 6,264,011 | 188,886,876 | 7,013,991 | 13,000 |
| 1938 | | | | | | |
| Dry and siliceous gold | 60,409 | 22,393 | 136,432 | 511,980 | 606,745 | |
| Dry and siliceous gold-silver | 17,386 | 4,319 | 186,915 | 114,051 | 579,381 | |
| Dry and siliceous silver | 27,394 | 656 | 475,072 | 75,744 | 44,449 | |
| Copper | 1,548,387 | 89,649 | 3,637,677 | 145,893,388 | 559 | |
| Lead | 5,956 | 868 | 87,116 | 56,776 | 2,003,669 | |
| Lead-copper | 69 | 16 | 2,232 | 5,303 | 17,717 | |
| | 1,659,601 | 117,901 | 4,525,444 | 146,657,242 | 3,252,520 | |

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties and districts, in terms of recovered metals*

| County and district | Mines producing | | Ore | Gold | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | | | | | |
| 1937 | | | | | | | | | | |
| Cochise County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Dos Cabezas and Tevis | 11 | 3 | 416 | 83 | 80 | 1,925 | 75,281 | 1,949 | | $16,418 |
| Hartford | 4 | | 103 | 79 | | 318 | 2,463 | 390 | | 3,332 |
| Swisshelm | 5 | | 772 | 100 | | 11,682 | 1,149 | 14,085 | | 13,506 |
| Tombstone | 16 | | 14,551 | 2,237 | | 160,958 | 41,132 | 629,932 | | 244,939 |
| Turquoise | 10 | | 2,583 | 20 | | 6,658 | 98,240 | 6,814 | | 18,139 |
| Warren | 6 | 1 | 1,086,259 | 69,535 | 2 | 3,491,735 | 111,982,727 | 2,036,305 | | 18,804,704 |
| Coconino County: | | | | | | | | | | |
| Jacob Canyon | 1 | | 770 | 4 | | 353 | 137,000 | | | 16,990 |
| Valle | 1 | | 52 | | | 31 | 21,694 | | | 2,649 |
| Gila County: | | | | | | | | | | |
| Banner | 8 | | 44,223 | 285 | | 38,318 | 1,563,124 | 2,409,813 | 1,018,000 | 437,101 |
| Globe | 28 | 1 | 9,734,324 | 2,878 | 6 | 190,468 | 177,018,025 | 46,322 | 13,000 | 21,671,026 |
| Green Valley | 10 | | 182 | 102 | | 97 | 6,711 | | | 4,457 |
| Pioneer and El Capitan [1] | 8 | | 302 | 3 | | 4,340 | 2,661 | 4,865 | | 4,071 |
| Roosevelt | 1 | | 51 | 48 | | | | | | 1,680 |
| Summit | 3 | | 93 | | | | 12,289 | | | 1,487 |
| Graham County: Aravaipa | 3 | | 312 | 3 | | 2,605 | 5,289 | 125,000 | | 10,135 |
| Greenlee County: | | | | | | | | | | |
| Ash Peak | 2 | | 52,518 | 1,615 | | 465,382 | 8,405 | 11,780 | | 418,210 |
| Copper King Mountain and Gold Mountain | 2 | | 88 | 36 | | 415 | 4,843 | 51 | | 2,170 |
| Copper Mountain | 6 | | 274 | 69 | | 1,607 | 13,644,322 | 5,169 | | 1,654,926 |
| Maricopa County: | | | | | | | | | | |
| Big Horn | 4 | 2 | 96 | 21 | 12 | 31 | | | | 1,179 |
| Cave Creek and Camp Creek | 9 | | 3,043 | 1,313 | | 1,501 | 2,785 | 678 | | 47,493 |
| Osborn | 9 | | 11,111 | 1,296 | | 23,916 | 289,752 | 139,186 | | 107,131 |
| Salt River Mountains | 6 | | 1,321 | 632 | | 640 | 3,967 | | | 23,095 |
| San Domingo | 1 | 17 | 50 | 7 | 35 | 14 | 4,595 | | | 2,037 |
| Sunflower | 2 | | 134 | 117 | | 159 | 504 | | | 4,279 |
| Vulture | 8 | 2 | 71,160 | 2,171 | 23 | 6,265 | 28,810 | 8,119 | | 85,601 |
| Winifred | 4 | | 98 | 44 | | 22 | 132 | | | 1,573 |
| Mohave County: | | | | | | | | | | |
| Cedar Valley | 3 | | 953 | 133 | | 1,320 | 29,413 | 2,170 | | 9,363 |
| Chemehuevis | 5 | 3 | 30 | 48 | 22 | 48 | 413 | 1,119 | | 2,603 |
| Cottonwood | 1 | | 132 | 21 | | 75 | 7,595 | | | 1,712 |
| Gold Basin | 4 | 7 | 13,373 | 930 | 20 | 291 | | 1,373 | | 33,556 |
| Greenwood | 4 | | 50 | 29 | | 9 | | | | 1,022 |
| Hacks Canyon | 3 | | 68 | | | 234 | 9,364 | | | 1,314 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lost Basin | | 1 | | | 77 | 18 | | | | 2,709 |
| Maynard and McConnico | 4 | | 850 | 371 | | 10,786 | 1,810 | 19,508 | 14,646 | 23,650 |
| Music Mountain | 3 | | 33 | 37 | | 75 | 33 | | | 1,357 |
| Owens | 16 | | 1,095 | 209 | | 10,075 | 5,694 | 52,390 | | 18,888 |
| San Francisco (including Gold Road, Katherine, and Oatman) | 30 | | 202,904 | 46,514 | | 64,467 | | | | 1,677,855 |
| Wallapai | 45 | | 119,246 | 15,348 | | 528,640 | 400,182 | 4,978,220 | 3,428,354 | 1,511,063 |
| Weaver | 8 | | 70,054 | 14,139 | | 24,840 | 620 | 220 | | 514,167 |
| Pima County: | | | | | | | | | | |
| Ajo | 3 | | 6,080,693 | 33,801 | | 436,004 | 110,750,066 | | | 14,921,042 |
| Amole | 8 | | 344 | 32 | | 892 | 12,347 | 44,271 | | 5,916 |
| Arivaca | 23 | [F] 6 | 315 | 138 | 17 | 1,952 | 7,917 | 1,932 | | 8,007 |
| Baboquivari | 3 | | 143 | 9 | | 671 | 5,843 | | | 1,541 |
| Cababi | 7 | | 381 | 155 | | 177 | 868 | | | 5,667 |
| Empire | 2 | | 283 | 10 | | 1,541 | 5,099 | 166,509 | | 11,983 |
| Greaterville | 4 | 8 | 67 | 16 | 32 | 600 | 215 | 8,169 | | 2,652 |
| Helvetia | 11 | | 1,403 | 101 | | 14,874 | 43,099 | | | 20,255 |
| Old Hat [2] | 2 | | 10,354 | 24 | | 6,265 | 441,901 | 1,000 | | 59,215 |
| Pima | 6 | | 357 | 9 | | 2,565 | 7,744 | 17,356 | | 4,260 |
| Quijotoa | 2 | | 257 | 37 | | 18 | 33 | | | 1,313 |
| Pinal County: | | | | | | | | | | |
| Bunker Hill | 5 | | 98,922 | 210 | | 9,651 | 2,791,504 | | | 352,587 |
| Casa Grande | 11 | | 452 | 87 | | 1,201 | 12,355 | 1,373 | | 5,550 |
| Goldfields | 5 | | 341 | 31 | | 2,512 | 4,868 | | | 3,617 |
| Hackberry | 4 | | 233 | 61 | | 967 | 2,843 | | | 3,227 |
| Martinez Canyon | 1 | | 4,451 | 11 | | 40,075 | 3,521 | 422,661 | | 56,746 |
| Mineral Creek | 7 | | 1,171,086 | 509 | | 23,099 | 34,615,149 | 64,780 | | 4,227,937 |
| Mineral Hill | 7 | | 1,593 | 20 | | 17,987 | 14,463 | 1,525 | | 16,453 |
| Old Hat [2] | 14 | 1 | 88,859 | 12,028 | 33 | 26,614 | 13,967 | 1,587,966 | | 538,101 |
| Pioneer [1] | 20 | | 332,368 | 14,102 | | 749,492 | 34,205,496 | 8,695 | | 5,212,680 |
| Ripsey | 1 | | 885 | 348 | | 7,404 | 12,719 | | | 19,446 |
| Riverside | 5 | | 85 | 11 | | 84 | 5,289 | 34 | | 1,092 |
| Santa Cruz County: | | | | | | | | | | |
| Harshaw | 15 | | 6,696 | 26 | | 87,320 | 27,066 | 1,968,695 | | 187,880 |
| Oro Blanco | 11 | | 140,138 | 6,634 | | 641,382 | 488,281 | 7,727,966 | 5,400,000 | 1,594,331 |
| Palmetto | 3 | | 447 | 4 | | 62 | 50,595 | 390 | | 6,333 |
| Patagonia | 17 | 1 | 450 | 28 | 2 | 4,596 | 20,843 | 65,966 | | 11,019 |
| Tyndall | 10 | | 105 | 2 | | 874 | 5,157 | 14,322 | | 2,215 |
| Wrightson | 4 | | 139 | 12 | | 693 | 3,281 | 18,813 | | 2,463 |
| Yavapai County: | | | | | | | | | | |
| Agua Fria | 4 | | 193 | 15 | | 123 | 52,529 | | | 6,980 |
| Big Bug | 31 | [F] 25 | 50,315 | 8,587 | 296 | 116,494 | 256,008 | 210,288 | | 444,397 |
| Black Canyon | 12 | 7 | 32,160 | 3,234 | 24 | 77,630 | 22,934 | 273,492 | | 192,988 |
| Black Rock | 16 | 1 | 572 | 134 | 2 | 115 | 46,802 | 1,390 | | 10,594 |
| Blue Tank | 6 | | 157 | 10 | | 31 | 13,529 | 1,034 | | 2,072 |
| Bullard | 2 | | 206 | 69 | | 110 | 21,430 | | | 5,093 |

[1] Pioneer district lies in both Gila and Pinal Counties.
[2] Old Hat district lies in both Pima and Pinal Counties.

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*Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore | Gold | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | | | | | |
| 1937—Continued | | | | | | | | | | |
| Yavapai County—Continued. | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Castle Creek | 5 | 3 | 176 | 45 | 67 | 4,265 | 6,628 | | | $8,021 |
| Cherry Creek | 12 | | 614 | 444 | | 843 | 4,066 | | | 16,684 |
| Copper Basin | 8 | 22 | 2,073 | 91 | 114 | 3,038 | 25,686 | 211,525 | 159,123 | 35,456 |
| Eureka | 20 | 1 | 122,138 | 8,463 | 17 | 150,048 | 1,549,041 | 1,192,356 | 18,877 | 671,872 |
| Hassayampa | 44 | 31 | 1,295 | 650 | 110 | 25,099 | 8,165 | 7,525 | | 47,446 |
| Humbug | 8 | 8 | 372 | 251 | 71 | 600 | 884 | | | 11,841 |
| Kirkland | 7 | | 144 | 128 | | 159 | 686 | 237 | | 4,700 |
| Lynx Creek | | 38 | | | 2,590 | 384 | | | | 90,947 |
| Martinez | 5 | | 988 | 622 | | 609 | 4,463 | | | 22,781 |
| Mineral Point | 4 | | 210 | 153 | | 212 | 1,091 | 492 | | 5,680 |
| Peck | 2 | 1 | 116 | 1 | 4 | 7,062 | 480 | 1,100 | | 5,760 |
| Pine Grove | 3 | | 3,841 | 2,054 | | 10,744 | 11,140 | 12,815 | | 82,305 |
| Silver Mountain | 3 | 1 | 208 | 137 | 4 | 437 | 1,083 | 1,017 | | 5,464 |
| Squaw Peak | 2 | | 191 | 20 | | 2,521 | 884 | 19,458 | | 3,905 |
| Tip Top | 3 | | 907 | 8 | | 31,263 | 256 | 3,712 | | 24,712 |
| Turkey Creek | 5 | 1 | 39 | 16 | 12 | 1,418 | 149 | 8,830 | | 2,616 |
| Verde | 2 | | 1,326,940 | 62,748 | | 1,840,150 | 84,742,620 | | | 13,873,393 |
| Walker | 11 | | 747 | 254 | | 1,669 | 9,777 | 10,746 | | 11,998 |
| Walnut Grove | 7 | 6 | 395 | 73 | 17 | 119 | 942 | 17 | | 3,357 |
| Weaver | 25 | 51 | 34,134 | 9,846 | 201 | 10,389 | 15,752 | 85,695 | | 366,643 |
| White Picacho | 4 | | 501 | 435 | | 128 | 6,818 | 271 | | 16,165 |
| Yuma County: | | | | | | | | | | |
| Castle Dome | 9 | | 168 | 172 | | 1,360 | 322 | 13,695 | | 7,919 |
| Cienega | 5 | | 51 | 16 | | 4 | 6,339 | | | 1,330 |
| Ellsworth [3] | 21 | | 591 | 267 | | 225 | 33,099 | 8,440 | | 14,022 |
| Eureka | 5 | | 81 | 19 | | 331 | | 13,034 | | 1,690 |
| Fortuna | 3 | 3 | 22 | 39 | 9 | 9 | | | | 1,687 |
| Laguna | 1 | 10 | 40 | 6 | 39 | 14 | | | | 1,586 |
| La Paz | 4 | 37 | 24 | 19 | 132 | 17 | | | | 5,298 |
| Muggins Mountains | 1 | 3 | 20 | 57 | 37 | 31 | | | | 3,314 |
| Plomosa | 9 | 45 | 245 | 116 | 183 | 137 | 521 | 424 | | 10,659 |
| Santa Maria | 4 | | 19,345 | 48 | | 1,607 | 1,116,843 | | | 138,061 |
| Other districts [4] | 70 | 29 | 619 | 115 | 109 | 3,262 | 31,480 | 12,526 | | 14,911 |
| Total Arizona | 888 | 376 | 20,976,359 | 328,295 | 4,399 | 9,422,552 | 576,956,000 | 24,708,000 | 10,052,000 | 90,855,462 |

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|---|---|---|---|---|---|---|---|---|---|---|
| Cochise County: | | | | | | | | | | |
| California | 5 | | 39 | 4 | | 249 | 214 | 18,326 | | 1,165 |
| Dos Cabezas and Tevis | 13 | 8 | 1,612 | 304 | 68 | 1,185 | 2,439 | 20,196 | | 14,954 |
| Swisshelm | 3 | | 265 | 112 | | 10,344 | 357 | 23,239 | | 11,711 |
| Tombstone | 8 | | 9,329 | 1,877 | | 104,346 | 31,980 | 629,435 | | 165,239 |
| Turquoise | 15 | | 1,141 | 87 | | 9,572 | 12,469 | 110,782 | | 15,551 |
| Warren | 5 | 2 | 919,185 | 53,892 | 3 | 2,594,377 | 95,036,663 | 27,500 | | 12,878,356 |
| Coconino County: | | | | | | | | | | |
| Jacob Canyon | 2 | | 243 | 3 | | 130 | 51,816 | | | 5,267 |
| Ryan | 2 | | 59 | | | 51 | 10,082 | | | 1,021 |
| Valle | 1 | | 145 | | | 82 | 48,653 | | | 4,821 |
| Gila County: | | | | | | | | | | |
| Banner | 12 | 2 | 8,951 | 918 | 8 | 8,565 | 340,816 | 604,304 | 47,000 | 101,401 |
| Globe | 30 | 2 | 4,824,508 | 1,170 | 10 | 57,666 | 89,055,123 | 20,305 | | 8,806,915 |
| Green Valley | 12 | 1 | 537 | 284 | 1 | 379 | 1,755 | | | 10,392 |
| Pioneer [1] | 5 | | 197 | 13 | | 6,268 | 2,663 | 391 | | 4,786 |
| Roosevelt | 1 | | 375 | 228 | | 215 | 184 | | | 8,137 |
| Summit | 3 | | 119 | 3 | | 232 | 17,796 | | | 1,999 |
| Graham County: Aravaipa | 9 | | 878 | 12 | | 9,405 | 22,694 | 310,217 | | 22,994 |
| Greenlee County: | | | | | | | | | | |
| Ash Peak | 2 | | 70,270 | 1,795 | | 530,012 | 9,388 | 18,500 | | 407,230 |
| Copper King Mountain | 2 | | 219 | 74 | | 594 | 4,837 | 196 | | 3,457 |
| Copper Mountain | 4 | | 302 | 94 | | 1,946 | 22,296,469 | 2,043 | | 2,189,696 |
| Maricopa County: | | | | | | | | | | |
| Big Horn | 6 | 3 | 1,175 | 79 | 18 | 99 | 867 | | | 3,544 |
| Cave Creek and Camp Creek | 11 | | 5,281 | 1,293 | | 2,011 | 114,643 | | | 57,790 |
| Ellsworth [3] | 3 | | 47 | 39 | | 17 | 316 | | | 1,407 |
| Estrella Mountains | 1 | | 44 | 29 | | 17 | 225 | | | 1,048 |
| Osborn | 3 | | 3,519 | 487 | | 7,722 | 103,847 | 9,717 | | 32,661 |
| Salt River Mountains | 3 | | 1,320 | 561 | | 481 | 2,898 | | | 20,230 |
| San Domingo | | 11 | | | 61 | 14 | | | | 2,144 |
| Vulture | 5 | 2 | 15,540 | 873 | 4 | 1,086 | 1,908 | | | 31,584 |
| Winifred | 5 | | 1,719 | 180 | | 113 | 653 | | | 6,437 |
| Mohave County: | | | | | | | | | | |
| Cedar Valley | 4 | | 2,652 | 321 | | 1,270 | 765 | 9,565 | | 12,571 |
| Chemehuevis | 9 | 6 | 299 | 134 | 29 | 133 | 1,031 | 1,065 | | 5,941 |
| Gold Basin | 13 | 7 | 8,078 | 918 | 46 | 294 | | 1,283 | | 33,989 |
| Greenwood | 7 | | 70 | 34 | | 14 | | | | 1,199 |
| Lost Basin | 2 | 2 | 69 | 63 | 11 | 14 | | | | 2,599 |
| Maynard and McConnico | 7 | | 1,144 | 570 | | 1,338 | | 1,044 | | 20,863 |
| Minnesota | 3 | | 4,096 | 1,388 | | 1,601 | | | | 49,615 |
| Music Mountain | 7 | | 244 | 145 | | 908 | | | | 5,662 |
| Owens | 21 | | 754 | 377 | | 2,560 | 17,153 | 4,500 | | 16,738 |
| San Francisco (including Gold Road, Katherine, and Oatman) | 47 | | 240,421 | 47,432 | | 78,326 | | 456 | | 1,710,776 |
| Wallapai | 59 | | 109,810 | 15,027 | | 560,518 | 311,163 | 4,007,239 | 3,319,812 | 1,262,478 |
| Weaver | 11 | | 77,614 | 13,226 | | 22,954 | | | | 477,749 |

[1] Pioneer district lies in both Gila and Pinal Counties.
[3] Ellsworth district lies in both Maricopa and Yuma Counties.
[4] Includes districts having a production valued at less than $1,000.

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*Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore | Gold | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | | | | | |
| 1938—Continued | | | | | | | | | | |
| Pima County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Ajo | 1 | | 4,979,870 | 24,399 | | 285,997 | 86,360,000 | | | $9,502,132 |
| Amole | 3 | | 72 | 6 | | 543 | 3,469 | 7,000 | | 1,223 |
| Arivaca | 21 | 6 | 219 | 104 | 19 | 1,980 | 1,143 | 3,435 | | 5,855 |
| Baboquivari | 4 | 2 | 414 | 153 | 5 | 2,642 | 694 | 239 | | 7,317 |
| Cababi | 6 | | 351 | 127 | | 1,912 | 4,194 | 15,065 | | 6,785 |
| Empire | 2 | | 25 | | | 1,301 | 969 | 4,435 | | 1,140 |
| Greaterville | 3 | 3 | 14 | | 32 | 34 | | 1,935 | | 1,231 |
| Helvetia | 7 | | 819 | 38 | | 9,637 | 18,184 | | | 9,342 |
| Old Hat [2] | 1 | | 12,858 | 49 | | 8,616 | 564,786 | | | 62,634 |
| Pima | 10 | | 76 | 1 | | 908 | 2,347 | 8,826 | | 1,258 |
| Roskruge | 1 | | 62 | 1 | | 4,288 | 2,204 | | | 3,023 |
| Pinal County: | | | | | | | | | | |
| Bunker Hill | 4 | | 79,610 | 457 | | 16,765 | 3,252,469 | 13,870 | | 346,213 |
| Casa Grande | 14 | | 830 | 317 | | 3,383 | 2,786 | 12,565 | | 14,133 |
| Cottonwood | 2 | | 119 | 59 | | 51 | 112 | | | 2,109 |
| Hackberry | 3 | | 59 | 20 | | 263 | 3,786 | | | 1,241 |
| Mineral Creek | 4 | | 1,098,290 | 446 | | 23,299 | 30,058,561 | 314,022 | | 2,990,856 |
| Mineral Hill | 6 | | 349 | 15 | | 5,380 | 3,694 | | | 4,365 |
| Old Hat [2] | 11 | 2 | 165,870 | 21,686 | 4 | 35,439 | 25,684 | 3,837,391 | | 961,097 |
| Pioneer [1] | 16 | | 362,060 | 12,146 | | 774,661 | 34,332,163 | | 1,650,000 | 4,369,653 |
| Ripsey | 3 | | 2,581 | 681 | | 17,868 | 27,500 | | | 38,081 |
| Riverside | 4 | | 235 | 36 | | 249 | 7,143 | | | 2,121 |
| Santa Cruz County: | | | | | | | | | | |
| Harshaw | 12 | | 1,367 | 25 | | 52,255 | 16,316 | 298,304 | | 49,977 |
| Oro Blanco | 19 | | 133,044 | 6,258 | | 552,174 | 485,316 | 8,300,413 | 6,530,000 | 1,318,811 |
| Patagonia | 7 | 2 | 264 | 52 | 2 | 1,830 | 7,796 | 31,022 | | 5,264 |
| Redrock | 3 | | 28 | 1 | | 1,932 | 11,102 | 2,413 | | 2,483 |
| Tyndall | 8 | | 24 | 3 | | 1,553 | 1,490 | 7,674 | | 1,608 |
| Yavapai County: | | | | | | | | | | |
| Agua Fria | 1 | | 72 | 3 | | 48 | 15,000 | | | 1,606 |
| Big Bug | 14 | 23 | 32,326 | 7,418 | 1,047 | 104,838 | 112,633 | 670,217 | | 405,917 |
| Black Canyon | 11 | 7 | 25,927 | 2,763 | 33 | 91,117 | 10,755 | 334,935 | | 173,225 |
| Black Rock | 14 | 1 | 172 | 272 | 3 | 246 | 4,571 | 19,370 | | 11,123 |
| Castle Creek | 3 | 5 | 68 | 41 | 29 | 3,304 | 286 | | | 4,614 |
| Cherry Creek | 19 | | 725 | 425 | | 775 | 5,888 | | | 15,953 |
| Copper Basin | 5 | 11 | 200 | 124 | 91 | 110 | 214 | 4,391 | | 7,819 |
| Eureka | 24 | 1 | 75,149 | 8,711 | 3 | 184,652 | 768,551 | 1,303,826 | 81,188 | 563,552 |
| Hassayampa | 60 | 20 | 2,522 | 1,216 | 103 | 14,768 | 16,653 | 11,522 | | 57,874 |
| Humbug | 5 | 11 | 212 | 204 | 36 | 1,007 | 439 | | | 9,094 |

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|---|---|---|---|---|---|---|---|---|---|---|
| Kirkland | 3 | 4 | 36 | 20 | 12 | 17 | 480 | | | 1,178 |
| Lynx Creek | | 22 | | | 2,108 | 311 | | | | 73,981 |
| Martinez | 7 | | 58,044 | 3,673 | | 10,395 | 7,051 | | | 135,966 |
| Mineral Point | 6 | | 338 | 142 | | 382 | | | | 5,217 |
| Peck | 8 | 1 | 395 | 26 | 3 | 26,529 | 1,296 | 1,196 | | 18,347 |
| Pine Grove | 8 | | 3,681 | 1,934 | | 19,472 | 27,265 | 2,174 | | 83,050 |
| Silver Mountain | 3 | 1 | 64 | 30 | 1 | 164 | 153 | 5,087 | | 1,440 |
| Tiger | 5 | | 99 | 45 | | 17 | | | | 1,586 |
| Tip Top | 4 | | 795 | 5 | | 22,227 | 122 | 1,609 | | 14,630 |
| Turkey Creek | 7 | 3 | 59 | 50 | 11 | 608 | 92 | 152 | | 2,544 |
| Verde | 3 | | 799,564 | 45,541 | | 1,144,652 | 57,863,745 | | | 8,004,559 |
| Walker | 19 | 2 | 915 | 262 | 6 | 4,588 | 19,429 | 391 | | 14,268 |
| Walnut Grove | 10 | 12 | 1,692 | 171 | 45 | 345 | 704 | 2,044 | | 7,946 |
| Weaver | 22 | 37 | 45,537 | 14,115 | 363 | 13,232 | 10,020 | 41,239 | | 518,163 |
| White Picacho | 7 | | 723 | 308 | | 1,915 | 9,592 | 12,065 | | 13,513 |
| Yuma County: | | | | | | | | | | |
| Castle Dome | 4 | | 367 | 619 | | 5,346 | 439 | 39,152 | | 26,965 |
| Dome | | 11 | | | 54 | 14 | | | | 1,899 |
| Ellsworth [3] | 19 | | 506 | 303 | | 461 | 14,306 | 3,326 | | 12,458 |
| Laguna | | 10 | | | 42 | 3 | | | | 1,472 |
| La Paz and Trigo | 3 | 22 | 7 | 85 | 191 | 45 | | | | 9,689 |
| La Posa | 2 | | 71 | 25 | | 116 | 3,796 | | | 1,322 |
| Plomosa and La Cholla | 6 | 28 | 318 | 201 | 376 | 3,199 | 500 | 1,587 | | 22,385 |
| Other districts [4] | 47 | 36 | 800 | 200 | 107 | 2,182 | 4,245 | 8,805 | | 12,977 |
| Total Arizona | 885 | 329 | 14,203,164 | 300,058 | 4,985 | 7,479,153 | 421,594,000 | 21,142,000 | 11,628,000 | 58,358,401 |

[1] Pioneer district lies in both Gila and Pinal Counties.
[2] Old Hat district lies in both Pima and Pinal Counties.
[3] Ellsworth district lies in both Maricopa and Yuma Counties.
[4] Includes districts having a production valued at less than $1,000.

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In the following review by counties and mining districts only the more important operations are mentioned. Many producing mines and several districts whose output was small, included in the foregoing tables, are omitted from this review.

## COCHISE COUNTY

*Dos Cabezas and Tevis district.*—In 1937 the metal output of the Dos Cabezas and Tevis district was chiefly copper ore from the Tout property, gold ore from the Good Luck and Golden Eagle mines, and placer gold from Inspiration Placers; Inspiration Placers, Inc., operated a dragline dredge and treated 3,116 cubic yards of gravel. In 1938 the plant handled 14,775 cubic yards. The increase in district gold production resulted from resumption of operations at the Dives property by Consolidated Gold Mines, Ltd., which installed a new 200-ton rod mill and treated about 1,500 tons of gold ore.

*Swisshelm district (Webb, Elfrida).*—Nearly all the output of the Swisshelm district in both 1937 and 1938 was gold-silver ore from the Alpine property operated by the Alpine Mining Co.

*Tombstone district.*—The value of the metal output of the Tombstone district in 1938 was $79,700 less than in 1937, owing chiefly to decline in output of gold-silver ore from the Tombstone (Bunker Hill) property, chief producer in the district. There was also a decrease in output of lead ore from the Tombstone Extension and Toughnut mines. The United States Smelting, Refining & Mining Co. suspended operations at the Toughnut mine in June 1937.

*Turquoise district (Courtland, Pearce, Gleeson).*—In 1937 the output of the Turquoise district was mostly silver ore from the Commonwealth mine treated by cyanidation, and copper ore from the Black Diamond and Casey mines. In 1938 the output of copper decreased as both mines were closed, but the output of gold, silver, and lead increased, owing to shipments of silver ore from the Mona mine, lead ore and gold-silver ore from the Silver Bill claim, and lead ore from the Dragoon, Elsicore, Garnet, American, and Arizona properties. The Commonwealth mine was virtually idle in 1938.

*Warren district (Bisbee, Lowell, Warren).*—The value of the metal output of the Warren district decreased from $18,804,704 in 1937 to $12,878,356 in 1938, chiefly as a result of curtailment in output of copper ore from the Copper Queen branch of the Phelps Dodge Corporation. There was also a large decrease in output of copper ore from the Denn and Holbrook mines and of gold ore and lead ore from the Shattuck mine. The Phelps Dodge Corporation operated its Copper Queen branch throughout both years, but the output of copper ore was 9 percent less in 1938 than in 1937. The Copper Queen branch was the largest producer of gold and silver in Arizona in both years and ranked second in copper. The Denn mine was operated throughout both years by the Shattuck Denn Mining Corporation. 105,697 tons of copper ore were shipped to a smelter in 1937 and 72,030 tons in 1938. Lessees operated the Shattuck mine in 1937 and shipped 7,423 tons of lead ore, 5,610 tons of gold ore, and 3,388 tons of copper ore; the property was idle in 1938. The output of copper-gold ore from the McKenna Lease at the Holbrook property (Phelps Dodge Corporation) declined from 42,600 to 5,784 tons.

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### COCONINO COUNTY

The metal output of Coconino County in both 1937 and 1938 was copper ore, chiefly from claims near Jacob Lake owned by the Los Angeles Exploration & Metals Corporation and operated by lessees. Other producers of copper ore in 1938 were the Pack Rat claim near Valle and the Brown Derby and Little Buck mines in the Ryan (Warm Springs) district.

### GILA COUNTY

*Banner district.*—The output of all metals except gold in the Banner district decreased considerably in 1938 from 1937 owing to the closing in March 1938 of the Christmas copper property and to the sharp decline in output of lead ore and zinc-lead ore from the "79" mine. The Christmas mine, idle since May 1932, was reopened early in 1937 by the Christmas Copper Corporation, and 30,170 tons of copper ore were shipped to a smelter; the output dropped to 6,098 tons in 1938. In 1937 the "79" Lead-Copper Co. was a large producer of lead and zinc, in consequence of the construction of a 60-ton flotation plant; the plant was completed in May, and during the remainder of the year 10,483 tons of zinc-lead ore were treated by concentration, and 3,435 tons of first-class lead ore were shipped to a smelter. In January 1938 the mine and mill were closed, owing to the decline in metal prices. The mine was reopened by lessees who shipped 19 cars of first-class lead ore to a smelter. The increase in district gold production in 1938 resulted chiefly from shipments of gold ore from the Gold Queen, Arizona Apex, and Inseparable mines and lead ore containing gold from the Arizona Apex and Oro Verde properties.

*Globe-Miami district.*—The value of the metal output of the Globe-Miami district decreased from $21,671,026 in 1937 to $8,806,915 in 1938 owing to curtailment in output of copper ore from the Inspiration and Miami properties. In 1937 the Inspiration Consolidated Copper Co. treated 5,122,636 tons of copper ore by leaching and concentration, but in 1938 the output dropped to 1,484,614 tons; most of the ore in 1938 was treated by straight leaching. The output of copper ore from the Miami mine, treated by leaching and concentration, declined from 4,602,205 to 3,338,845 tons. According to the company printed annual report for the year ended December 31, 1938, a small amount of molybdenite (valued at $32,000) was recovered (beginning in August) from copper sulfide concentrates. In 1937 most of the gold production of the district came from the Miami, Inspiration, Abbie, Golden Eagle, Old Dominion, and Porphyry Reserve properties; in 1938 most of it came from the Miami property.

*Green Valley district (Payson).*—The increase in production of gold in the Green Valley district in 1938 resulted chiefly from operation of the Gowan (Verde Falls) property; lessees shipped several cars of gold ore to a smelter. Other producers of gold ore in 1938 included the Tornado, Gray Eagle, and Gold Hill claims.

*Pioneer district.*—Nearly all the output of the Pioneer district in 1938 was silver ore from the Pioneer and El Capitan properties and gold-silver ore from the Marland (Stigall) and Little Four mines. The chief production in 1937 was silver ore from the El Capitan and Silver Dime properties.

*Roosevelt district.*—The output of the Roosevelt district in both 1937 and 1938 was rich gold ore from the Christmas Gift & Good Luck property; the output increased considerably in 1938.

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### GRAHAM COUNTY

Metal production in Graham County was greater in 1938 than in 1937 owing to increased shipments of lead-silver ore from mines near Klondyke in the Aravaipa district. In 1938 nearly all the output of the county was first-class lead-silver ore from the Grand Reef, Dogwater, Alaman, Aravaipa, and Shim Fein properties in the Aravaipa district; in 1937 most of the output came from the Shim Fein claim.

### GREENLEE COUNTY

The Ash Peak (Duncan) and Copper Mountain (Morenci) were the chief producing districts in Greenlee County in both 1937 and 1938. The Ash Peak mine, virtually the only producer in the Ash Peak district, was operated by Veta Mines, Inc. The company became a large producer of silver and gold in 1937, and the output of each metal increased in 1938. About 64,700 tons of silver ore were treated in the company flotation plant in 1938, and 5,560 tons of similar ore were shipped to a smelter. The output of the Copper Mountain district in both years was mostly copper recovered from leaching old caved stopes at the Morenci branch of the Phelps Dodge Corporation; the production of copper was much larger in 1938 than in 1937, and experimental work and development on the new Morenci ore body continued during 1938. The remainder of the county output in 1938 was chiefly gold ore and gold-silver ore from the Keating and Buzzard Shadow properties in the Copper Mountain district and gold ore from the Gray Mare and Polaris mines in the Copper King Mountain district.

### MARICOPA COUNTY

The value of the metal output of Maricopa County was $116,370 less in 1938 than in 1937, owing chiefly to decline in production of gold from the Vulture and Belmont-McNeil tailing dumps and from the Portmanteau mine. In 1937 more than 80 percent of the gold production of the county came from these three properties. In 1938 most of the production came from the Blue Bird, Portmanteau, and Maricopa mines in the Cave Creek district, the Vulture mine and tailings dump in the Vulture district, the Delta mine in the Salt River Mountains district, and the Belmont-McNeil mine and tailings dump in the Osborn district. Nearly all the ore output of the Cave Creek, Salt River Mountains, and Osborn districts was first-class gold ore shipped to smelters; gold ore from the Vulture mine was treated by amalgamation and concentration, and most of the old Vulture tailings were treated by cyanidation.

### MOHAVE COUNTY

*Cedar Valley district.*—The output of ore in the Cedar Valley district was much less in 1938 than in 1937, but production of gold was larger owing to increase in output of gold ore from the San Francisco mine. A new 40-ton flotation plant was constructed at the mine in 1938, and about 2,600 tons of ore were concentrated. Several thousand tons of tungsten ore from the Boriana mine were concentrated in 1937, but no ore was treated in 1938 as the mill was destroyed by fire; however, a new 150-ton concentration plant was built during the year.

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*Chemehuevis district.*—The chief production in the Chemehuevis district in 1938 was gold ore from the Gold Dome and Dinero mines and placer gold from the Chief claim.

*Gold Basin district.*—The value ($33,989) of the metal output of the Gold Basin district in 1938 was virtually the same as that in 1937. In 1937 nearly all the output was gold ore treated by cyanidation, chiefly from the Cyclopic property. In 1938, production of gold from this property decreased considerably, but the loss was more than offset by increases at the O. K. & Excelsior, Gold Hill, Golden Rule, Narrow Gauge (Fry), and M. O. mines.

*Maynard and McConnico district.*—The Bimetal (McGuire) property at McConnico was the most important producer in the Maynard and McConnico district in both 1937 and 1938; several hundred tons of gold ore were treated each year by cyanidation. The Dean mine 14 miles east of Kingman was a producer of zinc-lead-silver ore in 1937 but was idle in 1938. Gold-silver ore from the Democrat mine and gold ore from the Southern Cross and Fay properties were treated in 1938 in the Vivian custom mill.

*Minnesota district.*—The Pope mine 40 miles north of Chloride became a large producer of gold ore in 1938; the property was operated by the Arizona-California Exploration Co., and 4,073 tons of ore were treated in the custom cyanide mill of Producers Mines, Inc.

*Music Mountain district.*—Nearly all the output of the Music Mountain district in 1938 was gold ore from the Roosevelt, Music Mountain, and Wierth properties, treated by concentration and cyanidation in the Vivian custom mill.

*Owens (McCracken and Potts Mountain) district.*—In 1937 most of the output in the Owens district was silver-lead ore from the Silver Streak and McCracken mines; gold ore from the Yucca, Greenwood, Mahogany, Kimball, and Golden Eagle properties; and gold-copper ore from the New England mine. In 1938 the chief production was gold ore from the Yucca, Gold Leaf, New England, Gold Chief, and Adela properties; silver ore from the Silver Streak mine; and gold ore and copper ore from the New England mine.

*San Francisco (Oatman, Gold Road, Katherine, Vivian) district.*—Production of gold in the San Francisco district in 1938 was 47,432 fine ounces, an increase of 918 ounces over 1937; production of silver also increased, and the value of the total metal output rose from $1,677,855 to $1,710,776. The largest increase was in output of gold ore from the Goldroad mine of the United States Smelting, Refining & Mining Co. In both years the property was the leading gold producer in Mohave County and the largest producer of gold from siliceous ore in Arizona. The company operated its 300-ton cyanide plant throughout 1938 and treated 125,572 tons of gold ore and 15,769 tons of old tailings.

The output of gold ore and old tailings from 32 properties at Oatman and Gold Road was 203,706 tons in 1938, which yielded 42,457 ounces of gold and 32,438 ounces of silver, compared with 179,585 tons in 1937, which yielded 42,196 ounces of gold and 36,940 ounces of silver. The Tom Reed Gold Mines Co. operated its mine and 300-ton cyanide plant at Oatman continuously in 1938, but the output of gold ore dropped to 25,171 tons from 47,364 tons in 1937, resulting in a substantial decline in production of gold; the mill treated both company and custom ore. In 1938 the Big Jim mine of the United Eastern

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Mines Co. and the Gray Eagle mine of the Tom Reed Gold Mines Co. were operated as a joint lease by Johnston & Witcher Mines, Inc., and the Tom Reed Gold Mines Co.; 13,700 tons of gold ore were treated in the Tom Reed mill. Lessees continued to operate the Pioneer group in 1937 and 1938; 2,622 tons of gold ore were treated in the Tom Reed mill and 6,111 tons in the Vivian mill in 1938. Lessees also continued to operate the United Western mine, and 4,014 tons of gold ore were treated in the Tom Reed mill in 1938; the property was taken over late in the year by the Vivian Mining Co., and 838 additional tons of ore were treated in the Vivian mill. The Vivian Mining Co. constructed a new 100-ton flotation plant in April 1937 and later added cyanide leaching tanks to treat the gold concentrates; 14,941 tons of gold ore from the Vivian-Lelande group were treated during 1937. In February 1938 the company started buying custom ore, and by the end of the year the mill had treated 18,350 tons of ore, including 13,650 tons from custom shippers. Other large producers of gold ore at Oatman were the Gold Dust, Mossback, Telluride, and Oatman Queen.

The output of gold ore and gold-silver ore from 15 properties in the Katherine section of the San Francisco district was 36,715 tons in 1938, which yielded 4,975 ounces of gold and 45,888 ounces of silver, compared with 23,319 tons in 1937, which yielded 4,318 ounces of gold and 27,527 ounces of silver. Three properties—the Katherine, Arabian, and Philadelphia—operated by the Gold Standard Mines Corporation produced 33,930 tons of ore in 1938; the Katherine was by far the largest producer. The Gold Standard Mines Corporation operated its 300-ton cyanide plant continuously in 1937 and 1938 on both company and custom ore. In 1938 the mill treated 23,529 tons of gold ore from the Katherine mine, 7,659 tons of gold-silver ore from the Arabian mine, and 2,742 tons of gold ore from the Philadelphia mine. In 1938 other large producers of gold ore were the Frisco and Tyro mines. In 1937 the chief producers were the Tyro, Arabian, Philadelphia, Katherine, Frisco, and Pyramid properties.

*Wallapai district* (*Cerbat, Chloride, Mineral Park, Stockton Hill*).—The value of the metal output of the Wallapai district in 1938 was $1,262,478, a decrease of $248,585 from 1937. The output of ore and all the metals, except silver, was less than in 1937; the decline in production of lead was most pronounced. The Tennessee mine of the Tennessee-Schuylkill Corporation at Chloride was the most important producer in the district in both years, ranking second in the State as a zinc producer, second in lead, and seventh in gold. About 54,000 tons of zinc-lead ore from the mine were treated in the company flotation plant in 1938, a decrease from 59,990 tons in 1937; the mill also treated custom ore. The Diana property of the Arizona Magma Mining Co. at Chloride was an important producer of gold-silver ore in both 1937 and 1938; the company treated 25,086 tons of ore by flotation concentration in 1938, an increase of 5,219 tons over 1937. Keystone, Inc., was a large producer of silver ore and gold-silver ore in 1937 through operation of several properties at Mineral Park. In April 1938 the company sold its holdings, including a 100-ton flotation plant, to Alpha-Keystone Mines, Inc. The mill was used in 1938 to treat gold-silver ore from company mines and from custom shippers; most (about 17,500 tons) of the ore came from company mines—the Keystone, Summit, Alpha, Jemison, Blue Bell, and Miner's Hope.

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The Fountain Head mine was a large producer of gold ore of smelting grade in both 1937 and 1938. Other large producers in 1938 of gold ore were the Rainbow, Golden Eagle, Oro Plata, Idaho, and Lillian mines and of gold-silver ore the C. O. D., Minnesota-Connor, Juno, White Eagle, Golconda, and Good Hope properties. Silver ore from the Alpha, Prince George, Midnight, American Nettie, and Oro Plata properties and lead ore from the Golden Eagle, Fountain Head, White Eagle, St. Louis, and Samoa mines were shipped for smelting; zinc ore from the Idaho mine and zinc-lead ore from the Champion, Columbus, Tintic, and Mary Bell properties were concentrated. In 1937 the General Ore Reduction Co. built a 50-ton flotation plant at Chloride to treat custom ore. The company treated several thousand tons of ore from various mine dumps in the district during the last quarter of 1937 and the first quarter of 1938; operations were suspended in April.

*Weaver (Mocking Bird, Pilgrim, Portland) district.*—The value of the metal output of the Weaver district in 1938 was $477,749, a decrease of $36,418 from 1937. The output of both gold and silver was less than in 1937 owing to the large decline in output of gold ore from the Portland mine, the most important producer in the district in both years; 25,419 tons of gold ore were treated in the cyanide mill at Katherine compared with 44,325 tons in 1937. The Pilgrim mine, a large producer of gold ore in 1936, was operated from January 1 to May 31, 1937, by the Pioneer Gold Mining Co.; on June 1 the property and 100-ton flotation mill were purchased by Producers Mines, Inc. The mill operated throughout the year and treated a total of 18,750 tons of gold ore by concentration; nearly all the concentrates were amalgamated. In January 1938 the company completed conversion of the mill into a 300-ton cyanide plant, and it was used during the remainder of the year to treat both company and custom ore; 10,571 tons of gold ore and 20,236 tons of old tailings from the Pilgrim property were treated. Producers Mines, Inc., also purchased the Klondyke and Scout groups in 1937; these properties were large producers of gold ore in both 1937 and 1938. More than 14,000 tons of gold ore from the Klondyke mine and 3,250 tons of similar ore from the Scout property were treated in 1938 by cyanidation. The Mocking Bird mine was also a large producer of gold ore in both years. Other leading producers of gold ore in 1938 were the Dixie Gold and Dixie Queen properties.

### PIMA COUNTY

The output of gold, silver, and copper in Pima County declined markedly from 1937 to 1938, owing to curtailment in production of copper ore at the New Cornelia mine at Ajo, most important producer in the county. The output of copper ore from this mine declined 18 percent, and that of copper more than 24,000,000 pounds; however, the mine maintained its rank as the largest producer of copper in Arizona. About 4,980,000 tons of copper ore were treated in 1938 in the flotation plant. Considerable copper was produced in both 1937 and 1938 from the Old Hat (Santa Catalina Mountains) district as a result of operations by the Catalina Consolidated Copper Co. at the Geesaman & Daily groups. The company, organized early in 1937, built a new 100-ton flotation plant and from August to the end of the year treated 10,300 tons of copper ore; production continued

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until June 1938, when operations were suspended. The remainder of the county output in 1938 was mostly gold ore from the Allison mine in the Baboquivari district, the Jaeger property in the Cababi district, and various claims in the Arivaca district; and silver ore from the Blue Jay mine in the Helvetia district. The Blue Jay mine produced considerable silver ore in 1937 also. Most of the lead produced in the county in 1937 came from the State of Maine group in the Empire district; the property was idle in 1938.

### PINAL COUNTY

*Bunker Hill district* (*Copper Creek*).—The output of gold, silver, and copper in the Bunker Hill district was greater in 1938 than in 1937. Nearly all the output in both years was copper-molybdenum ore and old tailings from the Childs property, operated by the Arizona Molybdenum Corporation. In 1938 about 44,200 tons of ore and 35,000 tons of old tailings were treated by flotation concentration and 143 tons of high-grade copper ore were shipped for smelting.

*Casa Grande district.*—The value of the metal output of the Casa Grande district in 1938 was more than double that in 1937, owing to increase in shipments of gold ore from the Desert Queen, Turning Point, Greenback, Mammon, and Christmas Gift properties.

*Martinez Canyon district.*—The large output of silver and lead in the Martinez Canyon district in 1937 resulted from operations at the Silver Bell mine by the Sunbeam Gold Mining Co., the only producer. The company built a 50-ton flotation plant and treated about 3,000 tons of lead-silver ore; in addition, it shipped several hundred tons of first-class lead-silver ore and silver ore to a smelter. The property was idle in 1938.

*Mineral Creek district* (*Ray*).—The Nevada Consolidated Copper Corporation resumed operations at the Ray property in January 1937, and during the year treated 1,166,441 tons of copper ore in the 12,000-ton flotation plant; in addition, it shipped 3,678 tons of crude copper ore, 3,690 tons of copper precipitates, and 766 tons of old tailings for smelting. In 1938 the mine and mill were idle from June 16 to August 15, and the output of copper ore declined to 1,097,532 tons. As a result, the output of copper and gold from the Mineral Creek district decreased. There was, however, a large increase in the district output of lead in 1938 owing to shipments of lead ore from the Ray Silver-Lead property.

*Mineral Hill district.*—The chief production in the Mineral Hill district in both 1937 and 1938 was silver ore from the Rainbow Silver mine near Superior. The output of ore from the mine was much less in 1938 than in 1937.

*Old Hat district* (*Oracle, Mammoth*).—The value of the metal (gold, silver, copper, and lead) output of the Old Hat district in Pinal County was $961,097 in 1938, an increase of $422,996 over 1937. This substantial gain resulted from increase in output of ore from the Mammoth-St. Anthony property operated by Mammoth-St. Anthony, Ltd. The company treated 128,876 tons of ore in 1938 by gravity and flotation concentration and cyanide leaching. Lead concentrates (3,257 tons) containing considerable gold were smelted in the company 20-ton lead furnace; lead bullion, gold bullion, molybdenum, and vanadium were shipped to eastern markets. About 36,600 tons of

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similar ore from the New Year-Mohawk group were treated in the Mammoth-St. Anthony mill during 1938; the property, operated by the Molybdenum Gold Mining Co., was a large producer in 1937 also. The Catalina mine was a fairly large producer of gold ore in 1937 but was idle in 1938. The remainder of the district output in 1938 was mostly gold ore from the Old Gold Camp, Smith, North Star, and Bishop properties.

*Pioneer district* (*Superior*).—The value ($4,369,653) of the metal output of the Pioneer district in 1938 was greater than that of any other district in Pinal County, owing chiefly to the large output of gold, silver, copper, and zinc from the Magma mine, of gold from the Lake Superior & Arizona group, and of silver from the Reymert mine. The mine, mills, and smelter of the Magma Copper Co. were operated nearly all of 1938. The copper mill treated 246,690 tons of copper ore containing 0.027 ounce of gold and 1.18 ounces of silver to the ton and 5.12 percent copper; the new zinc unit treated 32,974 tons of zinc-copper ore containing 0.015 ounce of gold and 2.514 ounces of silver to the ton, 2.08 percent copper, and 8.41 percent zinc; and 54,975 tons of crude copper ore from the mine were smelted. In 1937, the output of the mine was 302,360 tons of copper ore; no zinc-copper ore was treated. The output of gold ore of smelting grade from the Lake Superior & Arizona group was 9,068 tons in 1938, a decrease of 1,645 tons from 1937; the ore contained 3,017 ounces of gold, 7,206 ounces of silver, and 101,229 pounds of copper. The Reymert mine was operated in both years by lessees; about 16,000 tons of silver ore were shipped in 1938 for smelting, an increase of 2,900 tons over 1937. The Belmont mine also was a large producer of silver ore during both years.

*Ripsey district.*—Production of gold, silver, and copper in the Ripsey district was much greater in 1938 than in 1937, owing to increased output of gold-silver ore from the Old Ripsey mine and to shipments of gold-silver ore from the Joe Fishback property. The Old Ripsey mine was the only producer in the district in 1937 and the most important producer in 1938.

*Riverside district.*—Nearly all the output of the Riverside district in 1938 was gold ore from the Arizona Gold and Lucky Strike mines and copper ore from the Peg Leg claim.

### SANTA CRUZ COUNTY

*Harshaw district.*—The value of the metal output of the Harshaw district was $137,903 less in 1938 than in 1937 owing to substantial reduction in output of lead-silver ore from several producers. The largest decrease (4,765 tons) was reported from the Trench mine. In 1937 the property was operated by the Gold Canyon Mining Co. and was the largest producer of silver and lead in the district. The American Smelting & Refining Co. purchased the mine in December 1937 and operated it throughout 1938, but the output of ore was small and came entirely from development, as no stoping was done. The Hardshell, World's Fair, Flux, Humboldt, and Salvador mines also were fairly large producers of lead and silver during both years.

*Oro Blanco district* (*Ruby*).—The Oro Blanco district is the chief producing area in Santa Cruz County, as the Montana mine of the Eagle-Picher Mining & Smelting Co. is in the district; this mine is

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the outstanding producer of lead and zinc in the State, ranks third in output of silver, and also produces much gold and copper. The output of zinc-lead ore from the mine and the yield of gold, silver, and copper were less in 1938 than in 1937, but production of lead and zinc was much greater; 132,450 dry tons of ore were treated in 1938 in the company 300-ton flotation plant. The remainder of the district output was mostly gold ore from the Old Glory & Sargent, Margarita, and Azteca properties and gold-silver ore from the Old Soldier claim.

*Palmetto district.*—Several cars of copper ore from the Three R property were shipped to a smelter in 1937, but the property was idle in 1938.

*Patagonia (Washington, Duquesne) district.*—In 1937 the output of the Patagonia district was mostly lead-silver ore from the Mowry, Pocahontas, and Empire properties and copper ore from the Paymaster claim. In 1938 the chief production was gold ore from the Guajolote mine and lead ore from the Duquesne property.

### YAVAPAI COUNTY

*Agua Fria district.*—The chief output in the Agua Fria district in both 1937 and 1938 was copper ore from the Burzog (Minor) property.

*Big Bug district.*—The value of the metal output of the Big Bug district decreased from $444,397 in 1937 to $405,917 in 1938 owing to the closing in October 1937 of the Gladstone-McCabe property, which made a large output of gold ore from 1934 to 1937, inclusive. The Iron King mine was the most important producer in the district in both 1937 and 1938. The property was operated by Burnham & Fields from January 1 to May 10, 1937, when it was purchased by the Iron King Mining Co.; a total of 22,602 tons of first-class gold ore was shipped for smelting in 1937. The company built a 200-ton flotation plant in 1938, which was placed in operation in September; 13,477 tons of gold ore were milled, and 17,078 tons of crude ore were shipped for smelting. The Belcher mine was a large producer of gold ore in 1937, and the old Blue Bell and Hackberry properties yielded a fairly large output of copper ore; the Belcher and Blue Bell properties were both idle in 1938, and the Hackberry mine was closed in February 1938. The output of placer gold in the district increased to 1,047 ounces in 1938 owing to operation of a dragline dredge at the Lawson group by the Hassayampa River Mining Co. and to operation of a washing plant, equipped with four Ainlay bowls, at Hill Placers.

*Black Canyon district.*—The value of the metal output of the Black Canyon district was $173,225 in 1938 compared with $192,988 in 1937; the output of gold and copper declined, but that of silver and lead increased. Two fairly important producers of gold in 1937—the Golden Belt and French Lily mines—were idle in 1938. The Golden Turkey Mining Co. was the chief producer in the district in both years. The company operated its mine and 50-ton flotation plant continuously, and the output of ore (25,765 tons) and production of gold (2,550 ounces) in 1938 were virtually the same as in 1937, but production of silver and lead was greater. The remainder of the district output in 1938 was chiefly rich silver ore from the Silver Cord and Thunderbolt mines.

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*Black Rock district.*—In 1937 the output of the Black Rock district was mostly copper ore from the Amazon and Paydirt properties. In 1938 the chief production was rich gold ore from the Gold Bar mine.

*Castle Creek district.*—Most of the lode output of the Castle Creek district in both 1937 and 1938 was silver ore from the Little Joker claim and gold ore from the Golden Aster mine. Placer gold was recovered largely from the Buckhorn property in 1937.

*Cherry Creek district.*—Metal production in the Cherry Creek district in 1938 was virtually the same as in 1937; nearly all the output in both years was gold ore of smelting grade. The chief producers in 1938 were the Logan, Sunnybrook, Cross Cut, Gold Bullion, Gold Eagle, D. D., Gold Ring, Fox No. 1, Red Pig, and Volcano properties.

*Copper Basin district.*—There was a substantial increase in the metal output of the Copper Basin district in 1937 over 1936 owing to operation of the U. S. group, idle for many years. This property was taken over early in 1937 by U. S. Mines, Inc.; about 1,600 tons of zinc-lead ore were hauled to the Yarnell flotation plant, and 244 tons of first-class lead ore were shipped to a smelter. However, the property was closed late in 1937 and was idle in 1938. Most of the remainder of the district lode output in 1937 was copper-gold ore from the Plymouth mine and zinc ore from the Boston-Arizona property. The chief production in 1938 was gold ore of smelting grade from the Gold Star and McNary properties and placer gold from the Smith & Roby claim.

*Eureka district.*—The value of the metal output of the Eureka district was $563,552 in 1938, a decrease of $108,320 from 1937. Production of gold, silver, lead, and zinc from the Hillside mine, most important producer in the district, was greater than in 1937, but there was a substantial decrease in output of copper ore from the Bagdad property as it was closed in April 1938. The Hillside mine and 200-ton flotation plant were operated continuously in 1938 by Hillside Mines, Inc., and 38,850 tons of gold-silver ore containing copper, lead, and zinc were concentrated; the property was a large producer of gold, silver, and lead. About 75,500 tons of copper ore from the Bagdad mine were treated by concentration in 1937, but the output dropped to 29,200 tons in 1938. Most of the remainder of the district output in 1937 was gold ore from the Oro Bueno, Turnbeaugh, and Belle-Mammoth properties. Comstock-Dexter Mines, Inc., built a 100-ton flotation plant at its property in 1938 and treated 4,220 tons of gold ore. The Santa Maria Mining Corporation was organized early in 1938 to operate several mines near Hillside, including the Turnbeaugh, Pocahontas, and Anarchist groups. The company purchased the 25-ton cyanide plant of the Oro Bueno Mining Co. and moved it to the Turnbeaugh property; during 1938 about 1,500 tons of gold ore were treated in the plant, and 340 tons were shipped for smelting. Other producers of gold ore in 1938 included the Mammoth-Belle, Mystery, Southern Cross, and Juan Olea properties.

*Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) district.*—The output of gold in the Hassayampa district increased from 760 fine ounces in 1937 to 1,319 ounces in 1938; however, the value of the metal output of the district has decreased considerably since the closing in September 1936 of properties operated by Bradshaw Mines, Inc. In 1937 the chief output was gold ore from the Climax,

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Alma, Great Divide, Pine Grove, Sacramento, and Storm Cloud properties and silver ore from the Cornucopia mine. In 1938 most of the production was gold ore from the Gold Basis, Great Divide, Sterling, Pine Grove, Climax, Sacramento, Ten Spot, Forest & Forlorn Hope, Alma, The Mary, and Hot Roll properties. Small-scale operations at various prospects in the district in both 1937 and 1938 resulted in shipments of small lots of rich gold ore.

*Humbug district.*—Rich gold ore from the Little Joseph, Humbug Gold Mines, and Acquisition properties was shipped in 1938 for smelting; the Little Joseph and Acquisition mines were producers in 1937 also. The placer output of the district in both years was recovered by various operators working on Cow, French, and Humbug Creeks.

*Lynx Creek district.*—Production in the Lynx Creek district in both 1937 and 1938 was placer gold and silver; it was recovered chiefly from property operated by the Lynx Creek Placer Mine Co. The company continued to be the largest producer of placer gold in the State, although its output was 18 percent less in 1938 than in 1937. The large floating washing plant and two draglines were operated continuously from January 1 to October 30, 1938, and treated 556,115 cubic yards of gravel.

*Martinez (Congress) district.*—The value of the metal output of the Martinez district increased from $22,781 in 1937 to $135,966 in 1938 owing to treatment of old Congress tailings and to shipments of low-grade gold ore from Congress waste dumps. The Congress Mining Corporation rebuilt the 300-ton cyanide plant at the Congress mine and from May to the end of 1938 treated 51,625 tons of old tailings; in addition, lessees shipped 5,536 tons of low-grade ore from the waste dumps for smelting. The rest of the district output in 1938 was mostly gold ore of smelting grade from the Coronado (Golden Wave), Blue Bird, and Key properties. Nearly all the output in 1937 was first-class gold ore from the Blue Bird and Coronado mines.

*Mineral Point district.*—In 1938 the output of the Mineral Point district was chiefly gold ore of smelting grade from the Buster and Lucky Joe claims. In 1937 the chief producers were the Emmett & Golden Eagle, Gold Dyke, and Gringo claims.

*Peck district.*—The Swastika mine near Cleator was the most important producer in the Peck district in both 1937 and 1938; several cars of rich silver ore were shipped each year for smelting.

*Pine Grove district.*—The value ($83,050) of the metal output of the Pine Grove district in 1938 was virtually the same as in 1937. The Gladiator-War Eagle property became a large producer of first-class gold ore of smelting grade in 1937, and shipments continued throughout 1938. Other producers of gold ore in 1938 were the Harrington, Oro Belle, and Del Pasco properties.

*Silver Mountain district (Wagoner).*—Gold ore from the Silver Dollar mine was the chief output of the Silver Mountain district in both 1937 and 1938. The property was operated by Colossal Mines, Inc., until May 5, 1938, when operations ceased.

*Tip Top district.*—Nearly all the output of the Tip Top district in both 1937 and 1938 was silver ore from the "76" mine; several hundred tons of ore were concentrated, and exceptionally rich silver ore was shipped to a smelter. The property was operated both years by the La Bajada Exploration, Engineering & Equipment Corporation.

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*Verde district* (*Jerome*).—The value of the metal output of the Verde district was $8,004,559 in 1938 compared with $13,873,393 in 1937. The loss resulted from curtailment in output of copper ore from the United Verde mine. The property (both the open-pit and underground sections of the mine) was operated continuously in 1938 by the Phelps Dodge Corporation; 557,762 tons of ore were smelted and 230,187 tons of ore were concentrated, but the output of copper ore declined 39 percent from 1937. The property ranked second in the State in production of gold and silver and third in copper. The 1,600-ton flotation plant and the 5,000-ton copper smelter owned by the company were operated throughout the year. However, the company dismantled one reverberatory furnace at the smelter and four Great Falls type converter stands and installed two new Pierce-Smith type converters. The United Verde Extension Mining Co. worked its mine until April 30, 1938, when operations were closed permanently and the company was dissolved. During the first 4 months of the year 7,762 tons of copper ore were shipped to the Phelps Dodge smelter at Clarkdale. The remainder of the district output in 1938 was gold-silver ore (3,853 tons) shipped from the Iron King-Equator group by A. B. Peach.

*Walker district.*—In 1937 most of the output of the Walker district was gold ore from the Golden Fleece, Farnum, and Cherry Grove claims. In 1938 the chief production was gold ore and gold-silver ore from the Sheldon mine.

*Walnut Grove district.*—Production of gold from both lode and placer mines in the Walnut Grove district in 1938 increased over 1937. The increase from lode properties resulted from operations at the Gold Bug-Gold Spring group by the Gallup Gold Mining Co. The company constructed a 100-ton cyanide plant in 1938, and 1,500 tons of gold ore were treated during the year. In 1937 Gold King Mines, Inc., operated the property and treated gold ore in a concentration mill. Various placer operators working on Placeritas Gulch and French Creek recovered more gold than in 1937.

*Weaver district* (*Octave*).—Production of gold in the Weaver district increased from 10,047 fine ounces in 1937 to 14,478 ounces in 1938, owing chiefly to the large output of gold ore from the Alvarado mine. However, the Octave mine remained the most important producer in the district, and its output of gold in 1938 was greater than in 1937. The mine and the flotation and cyanidation plant were operated continuously by the American Smelting & Refining Co.; 27,480 tons of gold ore were treated in 1938. Liberty Hill Gold Mines, Ltd., completed construction of a 75-ton cyanide plant at the Alvarado mine in June 1938, and during the last 6 months of the year the plant treated 14,808 tons of gold ore. The Johnson mine, a large producer of gold ore in 1937, was closed April 5, 1938, after treating 960 tons of gold ore by amalgamation and concentration. The Yarnell property also was a large producer of gold ore in 1937, but the mine and 50-ton flotation mill were idle most of 1938; about 1,300 tons of gold ore were concentrated during the last quarter of 1938. Other producers of gold ore in 1938 included the Dora, York, Cuba, and Rincon properties. The output of placer gold in the district increased from 201 fine ounces in 1937 to 363 ounces in 1938; the chief producer in 1938 was the Universal Placer Mining Corporation operating a 1¼-yard power shovel and a dry concentration plant at the Thunder Bird property.

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*White Picacho district.*—In 1937 nearly all the output of the White Picacho district was gold ore of smelting grade from the Young property 12 miles northeast of Morristown; in 1938 this mine was also the most important producer in the district. The Independence mine produced 65 tons of lead-silver ore in 1938.

### YUMA COUNTY

The value of the metal output of Yuma County was $78,907 in 1938, or $108,284 less than in 1937. This sharp decline resulted from the closing in September 1937 of the Swansea copper mine in the Santa Maria (Planet) district. The mine and 250-ton flotation mill were operated 8 months in 1937 by the American Smelting & Refining Co., 19,111 tons of copper ore were concentrated, and the property was by far the most important producer in the county; the mine was idle in 1938. More than a third of the gold produced in the county in both 1937 and 1938 was recovered by various placer operators, chiefly in the Plomosa, La Paz, Dome, and Laguna districts. The output of gold from lode mines in the county increased considerably in 1938, owing to increased shipments of rich gold ore (containing appreciable silver) from the Big Eye mine in the Castle Dome district. Most of the output in the Ellsworth district in 1938 was gold ore of smelting grade from the Golden Star, Desert, Gold Leaf, Blue Eagle, and Centroid properties and copper-gold ore from the Critic mine. Exceptionally rich gold ore was produced in 1938 from the Ah-Ve-Aha claim in the La Paz district. The chief output of the Plomosa district was gold ore from the Julius and Yum Yum properties and silver ore from the R. & A. mine.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

**(MINE REPORT)**

By CHARLES WHITE MERRILL AND H. M. GAYLORD [1]

## SUMMARY OUTLINE


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The total value of the gold, silver, copper, and lead recovered from ores, old tailings, and gravels in California in 1938—$47,767,894—was greater than that of the metal output in any year since 1856. The continued rise in total value in 1938 was due entirely to the expanding output of gold, as the values of silver, copper, and lead were all less than in 1937 and no zinc was produced in 1938.

Gold increased 12 percent in both quantity and value compared with 1937, whereas silver declined 10 percent in quantity and 25 percent in value; copper, 85 percent in quantity and 88 percent in value; and lead, 58 percent in quantity and 67 percent in value. No zinc output in 1938 was reported, but a small production was made in 1937. The total value of the five metals was 7 percent higher than in 1937; of the total, gold represented 96 percent, silver 3.5 percent, and copper and lead together less than 0.5 percent.

Nevada County continued in 1938 to be the largest contributor to the nonferrous metal wealth of California; it produced 24 percent of the State total value of the four metals, 25 percent of the total lode and placer gold, and 41 percent of the lode gold. Sacramento County (largely from gold dredging) contributed 10 percent of the total value of the four metals; Kern County (largely from gold and gold-silver ores), 8 percent; Amador County (two-thirds from gold ore and one-third from placer gravels), 8 percent; Calaveras County (three-fifths from gold ore and two-fifths from placer gravels), 6 percent; Yuba County (largely from gold dredging), 5 percent; and Merced County (largely from gold dredging), 4 percent. Thus, 7 of the 43 counties producing the metals in California in 1938 supplied two-thirds of the State total.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

[1] The assistance of O. Y. Sharman is acknowledged.



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Yardage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935-38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935-37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.

*Mine production of gold, silver, copper, lead, and zinc in California, 1934–38, and total, 1848–1938, in terms of recovered metals*

| Year | Mines producing | | Ore, old tailings, etc. (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 867 | 1,784 | 2,356,091 | 719,063.92 | $25,131,284 | 844,413 | $545,883 |
| 1935 | 1,112 | 1,487 | 3,337,773 | 890,430.00 | 31,165,050 | 1,191,112 | 856,112 |
| 1936 | 903 | 639 | 4,635,691 | 1,077,442.00 | 37,710,470 | 2,103,799 | 1,629,392 |
| 1937 | 913 | 838 | 4,925,014 | 1,174,578.00 | 41,110,230 | 2,888,265 | 2,234,073 |
| 1938 | 927 | 676 | 4,648,249 | 1,311,129.00 | 45,889,515 | 2,590,804 | 1,674,863 |
| 1848–1938 | -------- | -------- | [1] | 95,963,031.00 | 2,060,809,737 | 95,919,085 | 78,361,709 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 569,068 | $45,525 | 823,168 | $30,457 | 721,719 | $31,034 | $25,784,183 |
| 1935 | 1,954,000 | 162,182 | 1,134,000 | 45,360 | 322,000 | 14,168 | 32,242,872 |
| 1936 | 8,762,000 | 806,104 | 964,000 | 44,344 | 16,000 | 800 | 40,191,110 |
| 1937 | 10,502,000 | 1,270,742 | 2,372,000 | 139,948 | 40,000 | 2,600 | 44,757,593 |
| 1938 | 1,612,000 | 157,976 | 990,000 | 45,540 | ---------- | ---------- | 47,767,894 |
| 1848–1938 | [2] 578,009 | 188,948,592 | [2] 120,090 | 14,143,381 | [2] 51,958 | 9,378,886 | 2,351,642,305 |

[1] Figures not available.
[2] Short tons.

*Gold.*—During the 10-year period ended with 1938 the value of the gold output of California increased 438 percent—from $8,526,703 in 1929 to $45,889,515 in 1938; the gain in 1938 over 1937 alone was equivalent to more than half the total value of the output in 1929. In quantity the 1938 gold output was greater than in any year since 1862, and in value it was greater than in any year since 1856. Gold production in 1938 exceeded that in 1937 by 12 percent,, whereas

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production in 1937 exceeded that in 1936 by only 9 percent; this accelerating rate of increase is noteworthy in view of the upward trend that already has continued for 10 years.

Although the data for gold production in California before 1901 do not segregate placer and lode gold it appears certain that the output of lode gold was larger in 1938 in both quantity and value than in any year in the history of the State. The quantity and value of placer gold produced are known to be higher in 1938 than in any year since 1900. Moreover, it is probable that the placer miners have not enjoyed so productive a year since unrestricted hydraulic mining flourished, over 50 years ago. Even better days for placer mining were anticipated when construction of large débris dams on rivers in the Sierra Nevada Mountains was begun under supervision of the California Débris Commission with River and Harbor Work funds. Early in 1939 the first débris dam, that on the North Fork of American River near Auburn, was completed, making practicable the reopening

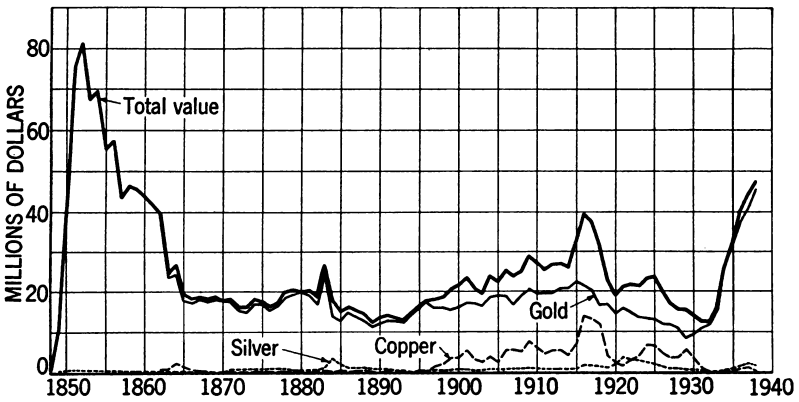


FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in California, 1848–1938. The value of lead and zinc has exceeded $1,000,000 in only a few years.

of a number of hydraulic mines in the large drainage basin above the dam. Another, the Upper Narrows Dam on Yuba River near Smartville, was projected for construction during 1939.

The 25 leading gold properties, listed in the following table, produced 56 percent of the total gold output of the State in 1938. Newcomers to the list in 1938 were 3 lode mines—the Cactus Queen, the Iron Mountain (which came just short of making the list in 1937), and the Sheepranch—and 4 connected-bucket dredging properties—the Merced dredge No. 1 of the Merced Dredging Co., the Butte Unit of Yuba Consolidated Gold Fields, the San Joaquin dredge No. 1 of the San Joaquin Mining Co., and the Yreka dredge of the Yreka Gold Dredging Co. These operations replaced on the list 4 lode mines and 3 connected-bucket dredging properties that failed to maintain their rank among the leading 25 gold producers in 1938. It will be noted that 12 of the 25 leading in 1938 derived their gold from gold ores, 11 from gravels worked by connected-bucket dredges, and the remaining 2 from gold-silver ores; the producers ranking first, second, and sixth are in the Grass Valley-Nevada City district.

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*Twenty-five leading gold producers in California in 1938, in approximate order of output*

| Mine | District | County | Operator | Source of gold |
|---|---|---|---|---|
| Empire Star mines | Grass Valley-Nevada City. | Nevada | Empire Star Mines Co., Ltd. | Gold ore. |
| Idaho Maryland | do | do | Idaho Maryland Mines Corporation. | Do. |
| Natomas Co | Folsom | Sacramento | Natomas Co | Dredge. |
| Yuba Unit | Yuba River | Yuba | Yuba Consolidated Gold Fields. | Do. |
| Capital dredge | Folsom | Sacramento | Capital Dredging Co | Do. |
| Lava Cap | Grass Valley-Nevada City. | Nevada | Lava Cap Gold Mining Corporation. | Gold ore. |
| Central Eureka and Old Eureka. | Mother Lode | Amador | Central Eureka Mining Co | Do. |
| Carson Hill | do | Calaveras | Carson Hill Gold Mining Corporation. | Do. |
| Golden Queen | Mojave | Kern | Golden Queen Mining Co | Do. |
| Merced Unit | Snelling | Merced | Yuba Consolidated Gold Fields. | Dredge. |
| Cactus Queen | Mojave | Kern | Cactus Mines Co | Gold - silver ore. |
| Snelling Unit | Snelling | Merced | Snelling Gold Dredging Co | Dredge. |
| Iron Mountain | Iron Mountain | Shasta | The Mountain Copper Co., Ltd. | Gold ore. |
| Merced dredge No. 1. | Snelling | Merced | Merced Dredging Co | Dredge. |
| Yellow Aster | Randsburg | Kern | Anglo American Mining Corporation, Ltd. | Gold ore. |
| Sheepranch | East Belt | Calaveras | St. Joseph Lead Co | Do. |
| Argonaut | Mother Lode | Amador | Argonaut Mining Co., Ltd | Do. |
| Sixteen to One | Alleghany | Sierra | Original Sixteen to One Mine, Inc. | Do. |
| Big Canyon | West Belt | Eldorado | The Mountain Copper Co., Ltd. | Do. |
| Arroyo Seco | Mother Lode | Amador | Arroyo Seco Gold Dredging Co. | Dredge. |
| Starlight | Mojave | Kern | Lodestar Mining Co | Gold - silver ore. |
| Butte Unit | Oroville | Butte | Yuba Consolidated Gold Fields. | Dredge. |
| San Joaquin dredge No. 1. | Snelling | Merced | San Joaquin Mining Co | Do. |
| Cosumnes dredge | Cosumnes River | Sacramento | Cosumnes Gold Dredging Co. | Do. |
| Yreka dredge | Greenhorn | Siskiyou | Yreka Gold Dredging Co | Do. |

*Silver.*—The bulk of the silver output of California in 1938 was more localized than that of the gold; the 10 leading properties, listed in the following table, produced 82 percent of the total silver. Newcomers to the list in 1938 were the Standard mine at Bodie (Mono County) and the Idaho Maryland mine at Grass Valley (Nevada County), which displaced on the list the Walker mine (Plumas County) and the Spanish mine (Nevada County). Of the 10 leaders, 5 produced gold-silver ores, 4 gold ores, and only 1 straight silver ore. In addition to the yield by the companies listed, some output of silver was reported from almost every lode and placer mine producing in the State in 1938.

*Ten leading silver producers in California in 1938, in approximate order of output*

| Mine | District | County | Operator | Source of silver |
|---|---|---|---|---|
| Cactus Queen | Mojave | Kern | Cactus Mines Co | Gold-silver ore. |
| Lava Cap | Grass Valley-Nevada City. | Nevada | Lava Cap Gold Mining Corporation. | Gold ore. |
| Starlight | Mojave | Kern | Lodestar Mining Co | Gold-silver ore. |
| Kelly | Randsburg | San Bernardino. | Frank Royer | Do. |
| Golden Queen | Mojave | Kern | Golden Queen Mining Co. | Gold ore. |
| Grigsby (Palisade) | Calistoga | Napa | Graham Loftus Oil Corporation. | Gold-silver ore. |
| Silverado-Kentuck | Mount Patterson | Mono | Sierra Consolidated Mines, Inc. | Silver ore. |
| Empire Star | Grass Valley-Nevada City. | Nevada | Empire Star Mines Co., Ltd. | Gold ore. |
| Standard | Bodie | Mono | Roseklip Mines Co | Gold-silver ore. |
| Idaho Maryland | Grass Valley-Nevada City. | Nevada | Idaho Maryland Mines Corporation. | Gold ore. |

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*Copper.*—The production of recoverable copper in California was much smaller in 1938 than in 1937, largely as a result of part-time operation at the Walker mine in the Genesee district of Plumas County. Despite curtailed operations, the Walker mine yielded three-fourths of the copper output of the State during 1938.

*Lead.*—The small output of recoverable lead in California in 1938 was mined principally in Inyo, Nevada, and Riverside Counties.

*Zinc.*—No zinc output in California in 1938 was reported.

*Gold produced at placer mines in California, 1934–38, by classes of mines and by methods of recovery*

| Class and method | Mines producing [1] | Material treated (cubic yards) | Gold recovered | | |
|---|---|---|---|---|---|
| | | | Fine ounces | Value | Average per cubic yard |
| Surface placers: | | | | | |
| Gravel mechanically handled: | | | | | |
| Connected-bucket dredges: [2] | | | | | |
| 1934 | 17 | 59,210,208 | 193,773.38 | $6,772,380 | $0.114 |
| 1935 | 20 | 75,014,000 | 236,403.70 | 8,274,130 | .110 |
| 1936 | 26 | 78,855,000 | 276,324.21 | 9,671,347 | .123 |
| 1937 | 33 | 94,809,000 | 322,961.00 | 11,303,635 | .119 |
| 1938 | 33 | 117,080,000 | 375,296.00 | 13,135,360 | .112 |
| Dragline dredges: [3] | | | | | |
| 1934 | 4 | 604,000 | 3,466.04 | 121,138 | .201 |
| 1935 | 24 | 3,906,000 | 22,191.47 | 776,701 | .199 |
| 1936 | 30 | 10,016,000 | 49,967.54 | 1,748,864 | .175 |
| 1937 | 51 | 19,364,000 | 94,142.00 | 3,294,970 | .170 |
| 1938 | 77 | 24,560,000 | 118,108.00 | 4,133,780 | .168 |
| Nonfloating washing plants: [4] | | | | | |
| 1934 | 27 | 949,000 | 5,831.48 | 203,810 | .206 |
| 1935 | 54 | 1,466,000 | 11,892.57 | 416,240 | .284 |
| 1936 | 50 | 1,433,000 | 12,059.39 | 422,079 | .295 |
| 1937 | 58 | 2,338,000 | 17,079.00 | 597,765 | .256 |
| 1938 | 74 | 3,538,000 | 23,046.00 | 806,610 | .228 |
| Gravel hydraulically handled: | | | | | |
| Hydraulic: | | | | | |
| 1934 | 58 | 1,614,000 | 9,281.75 | 324,397 | .201 |
| 1935 | 93 | 3,013,000 | 13,623.10 | 476,809 | .158 |
| 1936 | 84 | 1,878,000 | 7,670.01 | 268,450 | .142 |
| 1937 | 82 | 1,324,000 | 4,628.00 | 161,980 | .122 |
| 1938 | 86 | 1,719,000 | 7,061.00 | 247,135 | .144 |
| Small-scale hand methods: [5] | | | | | |
| Wet: | | | | | |
| 1934 | 1,569 | (6) | 48,495.54 | 1,694,919 | (6) |
| 1935 | 1,132 | (6) | 44,147.24 | 1,545,153 | (6) |
| 1936 | 326 | (6) | 39,132.00 | 1,369,620 | (6) |
| 1937 | 463 | 2,209,000 | 25,612.00 | 896,420 | .406 |
| 1938 | 292 | 2,863,500 | 41,686.00 | 1,459,010 | .510 |
| Dry: | | | | | |
| 1934 | 13 | 6,500 | 183.86 | 6,426 | .989 |
| 1935 | 21 | 6,500 | 128.40 | 4,494 | .691 |
| 1936 | 10 | 4,400 | 337.90 | 11,827 | 2.688 |
| 1937 | 30 | 14,000 | 486.00 | 17,010 | 1.215 |
| 1938 | 15 | 6,500 | 172.00 | 6,020 | .926 |

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[2] In 1934 there were 28 connected-bucket dredges in operation; in 1935, 36; in 1936, 40; in 1937, 46; and in 1938, 48.

[3] Includes all placer operations using dragline-type power shovel for excavating and delivering gravel to floating washing plant. Prior to 1936 no dragline operation had more than one dredge, but in 1936 there were 31 dragline dredges; in 1937, 55; and in 1938, 80.

[4] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."

[5] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry-washers, etc.

[6] Figures not available.

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*Gold produced at placer mines in California, 1934–38, by classes of mines and by methods of recovery*—Continued

| Class and method | Mines producing | Material treated (cubic yards) | Gold recovered | | |
|---|---|---|---|---|---|
| | | | Fine ounces | Value | Average per cubic yard |
| Underground placers: | | | | | |
| Drift: | | | | | |
| 1934 | 96 | 243,000 | 12,992.78 | $454,098 | $1.869 |
| 1935 | 143 | 141,000 | 17,139.52 | 599,883 | 4.254 |
| 1936 | 113 | 129,000 | 23,931.95 | 837,618 | 6.493 |
| 1937 | 121 | 98,000 | 7,398.00 | 258,930 | 2.642 |
| 1938 | 99 | 97,000 | 7,144.00 | 250,040 | 2.578 |
| Grand total placer: | | | | | |
| 1934 | 1,784 | (6) | 274,024.83 | 9,577,168 | (6) |
| 1935 | 1,487 | (6) | 345,526.00 | 12,093,410 | (6) |
| 1936 | 639 | (6) | 409,423.00 | 14,329,805 | (6) |
| 1937 | 838 | 120,156,000 | 472,306.00 | 16,530,710 | .138 |
| 1938 | 676 | 149,864,000 | 572,513.00 | 20,037,955 | .134 |

[6] Figures not available.

## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in California in 1938, by counties, in terms of recovered metals*

| County | Mines producing [1] | | Gold | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Lode | | Placer | | Total | |
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value | Fine ounces | Value |
| Alpine | 1 | | 1 | $35 | | | 1 | $35 |
| Amador | 43 | 28 | 70,310 | 2,460,850 | 36,114 | $1,263,990 | 106,424 | 3,724,840 |
| Butte | 18 | 38 | 13,538 | 473,830 | 40,244 | 1,408,540 | 53,782 | 1,882,370 |
| Calaveras | 55 | 50 | 50,390 | 1,763,650 | 32,645 | 1,142,575 | 83,035 | 2,906,225 |
| Del Norte | | 3 | | | 20 | 700 | 20 | 700 |
| Eldorado | 71 | 33 | 36,953 | 1,293,355 | 5,470 | 191,450 | 42,423 | 1,484,805 |
| Fresno | 3 | 3 | 27 | 945 | 286 | 10,010 | 313 | 10,955 |
| Humboldt | 1 | 10 | 19 | 665 | 576 | 20,160 | 595 | 20,825 |
| Imperial | 15 | 4 | 12,791 | 447,685 | 23 | 805 | 12,814 | 448,490 |
| Inyo | 81 | 9 | 17,736 | 620,760 | 128 | 4,480 | 17,864 | 625,240 |
| Kern | 128 | 11 | 85,072 | 2,977,520 | 1,631 | 57,085 | 86,703 | 3,034,605 |
| Lassen | 2 | 1 | 3 | 105 | 3 | 105 | 6 | 210 |
| Los Angeles | 12 | 10 | 4,509 | 157,815 | 397 | 13,895 | 4,906 | 171,710 |
| Madera | 14 | 14 | 76 | 2,660 | 195 | 6,825 | 271 | 9,485 |
| Mariposa | 70 | 17 | 23,497 | 822,395 | 7,412 | 259,420 | 30,909 | 1,081,815 |
| Merced | | 5 | | | 59,724 | 2,090,340 | 59,724 | 2,090,340 |
| Modoc | 1 | | 23 | 805 | | | 23 | 805 |
| Mono | 20 | 1 | 3,353 | 117,355 | 1 | 35 | 3,354 | 117,390 |
| Monterey | 1 | 1 | 57 | 1,995 | 4 | 140 | 61 | 2,135 |
| Napa | 1 | | 1,836 | 64,260 | | | 1,836 | 64,260 |
| Nevada | 30 | 29 | 300,733 | 10,525,655 | 21,025 | 735,875 | 321,758 | 11,261,530 |
| Orange | 1 | 1 | 1 | 35 | 6 | 210 | 7 | 245 |
| Placer | 26 | 67 | 19,772 | 692,020 | 31,827 | 1,113,945 | 51,599 | 1,805,965 |
| Plumas | 25 | 34 | 16,267 | 569,345 | 3,679 | 128,765 | 19,946 | 698,110 |
| Riverside | 25 | 5 | 2,092 | 73,220 | 108 | 3,780 | 2,200 | 77,000 |
| Sacramento | 2 | 15 | 130 | 4,550 | 141,974 | 4,969,090 | 142,104 | 4,973,640 |
| San Bernardino | 94 | 11 | 10,920 | 382,200 | 774 | 27,090 | 11,694 | 409,290 |
| San Diego | 5 | 3 | 82 | 2,870 | 6 | 210 | 88 | 3,080 |
| San Francisco | | (2) | | | 74 | 2,590 | 74 | 2,590 |
| San Joaquin | | 2 | | | 1,188 | 41,580 | 1,188 | 41,580 |
| San Luis Obispo | | 1 | | | 215 | 7,525 | 215 | 7,525 |
| Santa Clara | 1 | | 1 | 35 | | | 1 | 35 |
| Santa Cruz | | (2) | | | 10 | 350 | 10 | 350 |
| Shasta | 30 | 36 | 21,388 | 748,580 | 19,744 | 691,040 | 41,132 | 1,439,620 |
| Sierra | 20 | 38 | 20,989 | 734,615 | 4,739 | 165,865 | 25,728 | 900,480 |
| Siskiyou | 37 | 80 | 5,286 | 185,010 | 31,692 | 1,109,220 | 36,978 | 1,294,230 |
| Stanislaus | | 6 | | | 12,950 | 453,250 | 12,950 | 453,250 |
| Tehama | | 1 | | | 2,112 | 73,920 | 2,112 | 73,920 |
| Trinity | 24 | 64 | 1,020 | 35,700 | 40,447 | 1,415,645 | 41,467 | 1,451,345 |
| Tulare | 5 | 2 | 15 | 525 | 25 | 875 | 40 | 1,400 |
| Tuolumne | 56 | 21 | 13,532 | 473,620 | 10,882 | 380,870 | 24,414 | 854,490 |
| Ventura | 1 | | 19 | 665 | | | 19 | 665 |
| Yuba | 8 | 22 | 6,178 | 216,230 | 64,163 | 2,245,705 | 70,341 | 2,461,935 |
| | 927 | 676 | 738,616 | 25,851,560 | 572,513 | 20,037,955 | 1,311,129 | 45,889,515 |
| Total, 1937 | 913 | 838 | 702,272 | 24,579,520 | 472,306 | 16,530,710 | 1,174,578 | 41,110,230 |

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[2] Not reported.

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*Mine production of gold, silver, copper, lead, and zinc in California in 1938, by counties, in terms of recovered metals*—Continued

| County | Silver | | | | | |
|---|---|---|---|---|---|---|
| | Lode | | Placer | | Total | |
| | Fine ounces | Value | Fine ounces | Value | Fine ounces | Value |
| Alpine | 167 | $108 | | | 167 | $108 |
| Amador | 18,371 | 11,876 | 4,165 | $2,693 | 22,536 | 14,569 |
| Butte | 27,557 | 17,815 | 2,868 | 1,854 | 30,425 | 19,669 |
| Calaveras | 15,258 | 9,864 | 2,393 | 1,547 | 17,651 | 11,411 |
| Del Norte | | | 2 | 1 | 2 | 1 |
| Eldorado | 8,111 | 5,243 | 733 | 474 | 8,844 | 5,717 |
| Fresno | 5 | 3 | 49 | 32 | 54 | 35 |
| Humboldt | 6 | 4 | 83 | 54 | 89 | 58 |
| Imperial | 4,330 | 2,799 | 1 | 1 | 4,331 | 2,800 |
| Inyo | 41,095 | 26,566 | 23 | 15 | 41,118 | 26,581 |
| Kern | 1,148,080 | 742,193 | 97 | 63 | 1,148,177 | 742,256 |
| Lassen | 28 | 18 | | | 28 | 18 |
| Los Angeles | 1,819 | 1,176 | 68 | 44 | 1,887 | 1,220 |
| Madera | 31 | 20 | 55 | 36 | 86 | 56 |
| Mariposa | 6,969 | 4,505 | 1,004 | 649 | 7,973 | 5,154 |
| Merced | | | 5,859 | 3,788 | 5,859 | 3,788 |
| Modoc | 24 | 16 | | | 24 | 16 |
| Mono | 220,978 | 142,854 | | | 220,978 | 142,854 |
| Monterey | 3 | 2 | 2 | 1 | 5 | 3 |
| Napa | 148,337 | 95,895 | | | 148,337 | 95,895 |
| Nevada | 502,334 | 324,741 | 2,822 | 1,824 | 505,156 | 326,565 |
| Orange | 679 | 439 | 3 | 2 | 682 | 441 |
| Placer | 38,588 | 24,946 | 4,638 | 2,998 | 43,226 | 27,944 |
| Plumas | 53,528 | 34,604 | 399 | 258 | 53,927 | 34,862 |
| Riverside | 5,214 | 3,371 | 24 | 16 | 5,238 | 3,387 |
| Sacramento | 23 | 15 | 6,213 | 4,016 | 6,236 | 4,031 |
| San Bernardino | 257,327 | 166,353 | 43 | 28 | 257,370 | 166,381 |
| San Diego | 31 | 20 | | | 31 | 20 |
| San Francisco | | | 5 | 3 | 5 | 3 |
| San Joaquin | | | 92 | 59 | 92 | 59 |
| San Luis Obispo | | | 5 | 3 | 5 | 3 |
| Santa Clara | 1 | 1 | | | 1 | 1 |
| Santa Cruz | | | 2 | 1 | 2 | 1 |
| Shasta | 27,357 | 17,685 | 1,414 | 914 | 28,771 | 18,599 |
| Sierra | 4,306 | 2,784 | 503 | 325 | 4,809 | 3,109 |
| Siskiyou | 674 | 436 | 4,485 | 2,899 | 5,159 | 3,335 |
| Stanislaus | | | 1,332 | 861 | 1,332 | 861 |
| Tehama | | | 161 | 104 | 161 | 104 |
| Trinity | 253 | 164 | 4,375 | 2,828 | 4,628 | 2,992 |
| Tulare | 13 | 8 | 6 | 4 | 19 | 12 |
| Tuolumne | 5,451 | 3,524 | 1,578 | 1,020 | 7,029 | 4,544 |
| Ventura | 5 | 3 | | | 5 | 3 |
| Yuba | 4,063 | 2,626 | 4,286 | 2,771 | 8,349 | 5,397 |
| Total, 1937 | 2,541,016 | 1,642,677 | 49,788 | 32,186 | 2,590,804 | 1,674,863 |
| | 2,847,784 | 2,202,761 | 40,481 | 31,312 | 2,888,265 | 2,234,073 |

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*Mine production of gold, silver, copper, lead, and zinc in California in 1938, by counties, in terms of recovered metals*—Continued

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Alpine | | | | | | | $143 |
| Amador | 4,000 | $392 | | | | | 3,739,801 |
| Butte | | | | | | | 1,902,039 |
| Calaveras | 20,000 | 1,960 | 2,000 | $92 | | | 2,919,688 |
| Del Norte | | | | | | | 701 |
| Eldorado | 42,000 | 4,116 | 2,000 | 92 | | | 1,494,730 |
| Fresno | | | | | | | 10,990 |
| Humboldt | | | | | | | 20,883 |
| Imperial | 70,000 | 6,860 | | | | | 458,150 |
| Inyo | 62,000 | 6,076 | 392,000 | 18,032 | | | 675,929 |
| Kern | | | 4,000 | 184 | | | 3,777,045 |
| Lassen | | | | | | | 228 |
| Los Angeles | 2,000 | 196 | | | | | 173,126 |
| Madera | | | | | | | 9,541 |
| Mariposa | 4,000 | 392 | | | | | 1,087,361 |
| Merced | | | | | | | 2,094,128 |
| Modoc | | | | | | | 821 |
| Mono | 4,000 | 392 | 4,000 | 184 | | | 260,820 |
| Monterey | | | | | | | 2,138 |
| Napa | 4,000 | 392 | | | | | 160,547 |
| Nevada | 124,000 | 12,152 | 296,000 | 13,616 | | | 11,613,863 |
| Orange | | | 2,000 | 92 | | | 778 |
| Placer | 6,000 | 588 | 16,000 | 736 | | | 1,835,233 |
| Plumas | 1,204,000 | 117,992 | 2,000 | 92 | | | 851,056 |
| Riverside | 14,000 | 1,372 | 234,000 | 10,764 | | | 92,523 |
| Sacramento | | | | | | | 4,977,671 |
| San Bernardino | 44,000 | 4,312 | 26,000 | 1,196 | | | 581,179 |
| San Diego | 6,000 | 588 | | | | | 3,688 |
| San Francisco | | | | | | | 2,593 |
| San Joaquin | | | | | | | 41,639 |
| San Luis Obispo | | | | | | | 7,528 |
| Santa Clara | | | | | | | 36 |
| Santa Cruz | | | | | | | 351 |
| Shasta | | | 2,000 | 92 | | | 1,458,311 |
| Sierra | | | 8,000 | 368 | | | 903,957 |
| Siskiyou | | | | | | | 1,297,565 |
| Stanislaus | | | | | | | 454,111 |
| Tehama | | | | | | | 74,024 |
| Trinity | | | | | | | 1,454,337 |
| Tulare | | | | | | | 1,412 |
| Tuolumne | 2,000 | 196 | | | | | 859,230 |
| Ventura | | | | | | | 668 |
| Yuba | | | | | | | 2,467,332 |
| | 1,612,000 | 157,976 | 990,000 | 45,540 | | | 47,767,894 |
| Total, 1937 | 10,502,000 | 1,270,742 | 2,372,000 | 139,948 | 40,000 | $2,600 | 44,757,593 |

*Ore treated and gold and silver recovered at gold mills in the Mother Lode counties in California in 1938* [1]

| County | Ore treated | Gold and silver recovered in bullion | | | Concentrates produced [2] | Gold and silver recovered from concentrates smelted | | | Value of total recovery | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Gold | Silver | Average value per ton of ore | | Gold | Silver | Average value per ton of concentrates | Total | Average value per ton of ore |
| | *Short tons* | *Fine ounces* | *Fine ounces* | | *Short tons* | *Fine ounces* | *Fine ounces* | | | |
| Amador | 190,790 | 47,810 | 10,312 | $8.81 | 2,257 | 8,941 | 3,410 | $139.63 | $1,995,156 | $10.46 |
| Calaveras | 518,626 | 37,944 | 8,809 | 2.57 | 2,873 | 11,834 | 5,227 | 145.34 | 1,751,304 | 3.38 |
| Eldorado | 61,016 | 18,574 | 2,983 | 10.69 | 1,347 | 5,743 | 1,069 | 149.74 | 853,714 | 13.99 |
| Mariposa | 100,520 | 11,411 | 3,083 | 3.99 | 2,078 | 11,921 | 3,744 | 201.95 | 821,033 | 8.17 |
| Tuolumne | 60,700 | 6,407 | 1,495 | 3.71 | 692 | 1,885 | 1,778 | 97.00 | 292,336 | 4.82 |
| | 931,652 | 122,146 | 26,682 | 4.61 | 9,247 | 40,324 | 15,228 | 153.69 | 5,713,543 | 6.13 |
| Total, 1937 | 1,064,908 | 113,995 | 29,154 | 3.77 | 10,116 | 33,943 | 12,361 | 118.38 | 5,209,943 | 4.89 |

[1] Old tailings and mill cleanings excluded.
[2] Includes only concentrates recovered from gold ore.

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## MINING INDUSTRY

The decrease in combined value of the output of copper, lead, and zinc more than offset the net increase in combined value of the output of lode gold and silver in California in 1938; the total value of the output of the five metals from lode mines was equivalent to 98 percent of that in 1937. It was the placer-mining section of the industry that was responsible for the rising total value of the output of the five metals in 1938; the value of placer production increased 21 percent compared with 1937. In 1938, 44 percent of the State gold output was recovered at placer mines compared with 40 percent in the preceding year.

Dredges of the connected-bucket type handled 78 percent of the gravel mined and recovered 66 percent of the placer gold in 1938—a very small decline from the proportion of the total gravel handled and the total gold recovered by this method in 1937.

The second most important method—dragline dredging [2]—continued its spectacular rise as a means of recovering placer gold. The first dragline dredge production in the United States was reported in California in 1933, when two outfits, starting work late in the year, recovered less than 100 ounces of gold. In 1938, 77 operations were working 80 outfits; they treated 16 percent of the yardage and recovered 21 percent of the gold produced at placer mines. A small but progressive decline in the average value of gold recovered per cubic yard by dragline dredges has been noted since 1934, whereas the average recovered by connected-bucket dredges has varied little; in 1938 the average recovery per yard by dragline was $0.056 higher than the average ($0.112) by connected-bucket dredges.

Nonfloating washing plants to which gravel was delivered by mechanical means showed a large increase in yardage handled in 1938 over 1937, but the average gold recovered from the material treated continued to decline from the average in 1935 to 1937. Some of these nonfloating washing plants were stationary; others were built to move on skids, wheels, tracks, or by other means. Dragline excavators, power shovels, slack-line excavators, trucks, and other machines were used in delivering the gravel to these washing plants.

Small-scale hand methods, described in a recent report,[3] showed a substantial increase in 1938 over 1937, due perhaps to continuance of industrial unemployment.

Increases in yardage treated and gold recovered in 1938 at hydraulic mines but small decreases at drift mines were reported.

### ORE CLASSIFICATION

Of the 4,648,249 tons of ore (including 988,330 tons of old tailings) sold or treated in 1938, 94 percent was dry and siliceous gold ore, 4 percent dry and siliceous gold-silver ore, and most of the remainder copper ore. In 1937 there was a much larger proportion of copper ore and more silver ore and a smaller proportion of gold ore and gold-silver ore.

[2] Merrill, Charles White, Dragline Dredges—A New Way to Mine Placer Gold: Min. and Met., December 1938, pp. 521–525.
Gardner, E. D., and Allsman, Paul T., Power-Shovel and Dragline Placer Mining: Bureau of Mines Inf. Circ. 7013, 1938, 68 pp.

[3] Merrill, Charles White, Henderson, Chas. W., and Kiessling, O. E., Small-Scale Placer Mines as a Source of Gold, Employment, and Livelihood in 1935: Mineral Technology and Output-per-Man Studies, W. P. A. National Research Project Rept. E-2, May 1937, 28 pp.

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Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore and old tailings sold or treated in California in 1938, with content in terms of recovered metals*

| Source | Material sold or treated | | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | | | | | |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 3,408,735 | 977,917 | 700,256 | 980,568 | 358,000 | 648,300 | ---- |
| Dry and siliceous gold-silver ore | 181,006 | 2,912 | 35,496 | 1,325,777 | 32,200 | 100 | ---- |
| Dry and siliceous silver ore | 2,391 | 7,501 | 144 | 169,131 | 4,300 | 3,300 | ---- |
| | 3,592,132 | 988,330 | 735,896 | 2,475,476 | 394,500 | 651,700 | ---- |
| Copper ore | 66,943 | ---- | 2,295 | 47,016 | 1,209,600 | 500 | ---- |
| Lead ore | 844 | ---- | 425 | 18,524 | 7,900 | 337,800 | ---- |
| Total, lode mines | 3,659,919 | 988,330 | 738,616 | 2,541,016 | 1,612,000 | 990,000 | ---- |
| Total, placers | ---- | ---- | 572,513 | 49,788 | ---- | ---- | ---- |
| | 3,659,919 | 988,330 | 1,311,129 | 2,590,804 | 1,612,000 | 990,000 | ---- |
| Total, 1937 | 3,640,467 | 1,284,547 | 1,174,578 | 2,888,265 | 10,502,000 | 2,372,000 | 40,000 |

## METALLURGIC INDUSTRY

During 1938, as in former years, the bulk of the ore and virtually all the old tailings were treated at amalgamation and cyanidation mills (with or without concentration equipment); 70 percent of the total ore and 91 percent of the combined ore and old tailings were treated at such mills in 1938. Almost all the remaining ore and all the rest of the old tailings were treated at concentrating mills. A total of 12,750 tons of ore was shipped for direct smelting. Comparing 1938 with 1937 there was an increase of 11 percent in ore and a decrease of 23 percent in old tailings treated at gold and silver mills; the total ore and old tailings so treated in the 2 years varied less than 1 percent. The quantity of material treated in 1938 at concentrating mills decreased 43 percent and the quantity of crude ore smelted 46 percent. The decrease in quantity of concentrates shipped in 1938 for smelting was due in part to limited operations at the Walker mine in Plumas County, which made very large shipments of copper concentrates in 1937. The dry gold concentrates shipped in 1938 were of higher grade than those shipped in 1937.

Most companies mining in California in 1938 owned and operated their own metallurgical plants, but a number of custom mills also were operated in the State. The leading operators of metallurgical plants receiving custom material were the Idaho Maryland Mines Corporation, Grass Valley, Nevada County (cyanidation of ore and concentrates); Amador Metals Reduction Co., Jackson, Amador County (cyanidation of concentrates); Burton Bros., Inc., Rosamond, Kern County (cyanidation of ores); Western Graphite Co., Lake Hughes, Los Angeles County (flotation of ore); Golden Queen Mining Co., Mojave, Kern County (cyanidation of ore); and Keeler Gold Mines, Inc., Keeler, Inyo County (cyanidation of ore). During 1938 the Amador Metals Reduction Co. and Western Graphite Co. ceased operations, and by the end of the year their plants had been dismantled. It is interesting to note that these two plants were the only

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ones in the group that did not derive part of the material treated from mines managed by their operators. The largest metallurgical custom plant in California continued to be the State's only smelter—the Selby lead plant of the American Smelting & Refining Co., Selby, Contra Costa County.

*Mine production of metals in California in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore and old tailings amalgamated | 2,548,159 | 337,514 | 63,930 | | | |
| Ore, old tailings, sands, slimes, and concentrates cyanided | 2,382,255 | 232,113 | 891,087 | | | |
| Concentrates smelted: | | | | | | |
| Flotation | 35,425 | 146,917 | 1,298,406 | 1,532,200 | 625,000 | |
| Gravity | 2,477 | 11,745 | 16,049 | 9,200 | 15,600 | |
| Ore smelted | 12,750 | 10,327 | 271,544 | 70,600 | 349,400 | |
| Total, lode mines | | 738,616 | 2,541,016 | 1,612,000 | 990,000 | |
| Total, placers | | 572,513 | 49,788 | | | |
| | | 1,311,129 | 2,590,804 | 1,612,000 | 990,000 | |
| Total, 1937 | | 1,174,578 | 2,888,265 | 10,502,000 | 2,372,000 | 40,000 |

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1938, by types of mills and by counties, in terms of recovered metals*

AMALGAMATION MILLS

| County | Material treated | | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Amador | 190,682 | 500 | 48,936 | 9,799 | 2,257 | 8,941 | 3,410 | 4,000 | |
| Butte | 72,424 | | 3,827 | 3,711 | 1 | 2 | 1 | | |
| Calaveras | 518,600 | 350 | 22,689 | 2,823 | 2,873 | 11,834 | 5,227 | 5,600 | 2,000 |
| Eldorado | 41,195 | 50 | 14,972 | 2,392 | 1,346 | 5,736 | 1,068 | 5,800 | |
| Fresno | 29 | | 27 | 5 | | | | | |
| Humboldt | 35 | | 19 | 6 | | | | | |
| Imperial | 1 | | 6 | 2 | | | | | |
| Inyo | 6,331 | 105 | 1,245 | 288 | 5 | 59 | 229 | | |
| Kern | 209,382 | 1,129 | 17,065 | 5,008 | 40 | 165 | 95 | | 200 |
| Lassen | 4 | | 2 | 1 | | | | | |
| Los Angeles | 10,657 | 1,800 | 3,330 | 721 | 182 | 903 | 757 | 2,000 | |
| Madera | 314 | | 73 | 31 | | | | | |
| Mariposa | 100,490 | 60 | 11,206 | 2,791 | 2,078 | 11,921 | 3,744 | 4,000 | |
| Modoc | 400 | | 20 | 14 | 1 | 3 | 10 | | |
| Mono | 5,162 | | 925 | 408 | 2 | 5 | 21 | | |
| Monterey | 120 | | 20 | 1 | 4 | 37 | 2 | | |
| Nevada | 1,023,602 | | 159,654 | 24,499 | 6,929 | 33,908 | 306,441 | 41,600 | 67,700 |
| Placer | 106,613 | 2,646 | 14,748 | 4,056 | 755 | 3,537 | 31,645 | 4,300 | 16,000 |
| Plumas | 34,977 | | 3,115 | 618 | 81 | 1,504 | 267 | | |
| Riverside | 4,343 | 22 | 1,404 | 442 | 27 | 112 | 37 | | |
| Sacramento | 1 | | 127 | 21 | | | | | |
| San Bernardino | 3,551 | 85 | 974 | 267 | 35 | 671 | 7,036 | 300 | 8,900 |
| San Diego | 98 | | 29 | 7 | | | | | |
| Santa Clara | 1 | | 1 | 1 | | | | | |
| Shasta | 9,845 | | 2,848 | 679 | 125 | 1,085 | 329 | | 1,400 |
| Sierra | 52,196 | 1,000 | 18,582 | 3,387 | 350 | 1,370 | 455 | | |
| Siskiyou | 83,868 | | 4,774 | 532 | 179 | 386 | 62 | | |
| Trinity | 3,482 | | 771 | 152 | 3 | 32 | 22 | | |
| Tulare | 73 | | 13 | 5 | | | | | |
| Tuolumne | 52,541 | 5,897 | 5,713 | 1,204 | 692 | 1,885 | 1,778 | 1,000 | |
| Ventura | 75 | | 18 | 4 | 1 | 1 | 1 | | |
| Yuba | 2,557 | 866 | 381 | 55 | 3 | 14 | 2 | | |
| | 2,533,649 | 14,510 | 337,514 | 63,930 | 17,969 | 84,111 | 362,639 | 68,600 | 96,200 |
| Total, 1937 | 2,383,152 | 59,752 | 370,004 | 214,639 | 20,339 | 82,261 | 311,380 | 82,900 | 137,400 |

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*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1938, by types of mills and by counties, in terms of recovered metals*—Continued

CYANIDATION MILLS

| County | Material treated | | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ore [1] | Old tailings | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Amador | 1,134 | 544,653 | 12,290 | 5,090 | | | | | |
| Butte | 25,400 | | 7,614 | 18,397 | 187 | 2,049 | 5,438 | | |
| Calaveras | 380,105 | | 15,265 | 5,991 | | | | | |
| Eldorado | 19,821 | | 3,604 | 592 | 1 | 7 | 1 | | |
| Imperial | 12,566 | 6,680 | 4,892 | 1,223 | | | | | |
| Inyo | 25,144 | 7,530 | 6,525 | 16,185 | 7 | 11 | 49 | | |
| Kern | 219,914 | 379,607 | 49,893 | 605,924 | 188 | 12,811 | 530,460 | | |
| Los Angeles | 1 | | 1 | 1 | | | | | |
| Madera | | 133 | 3 | | | | | | |
| Mariposa | 97 | 3,015 | 360 | 418 | | | | | |
| Mono | 65,297 | 800 | 2,255 | 66,680 | | | | | |
| Nevada | 372,004 | 12,950 | 99,035 | 120,686 | 2,361 | 3,566 | 38,687 | 81,300 | 222,700 |
| Placer | 5,616 | | 871 | 2,064 | | | | | |
| Plumas | 5 | 1,671 | 76 | 54 | | | | | |
| Riverside | 509 | | 154 | 31 | 1 | 1 | | | |
| San Bernardino | 14,583 | 10,727 | 6,211 | 17,515 | 1 | 7 | 8 | | |
| San Diego | 15 | | 25 | 12 | | | | | |
| Shasta | 260,003 | | 16,097 | 25,774 | 11 | 221 | 208 | | |
| Sierra | 1,121 | | 150 | 10 | 18 | 61 | 39 | | |
| Siskiyou | 233 | 1,179 | 113 | 69 | | | | | |
| Trinity | 80 | 500 | 151 | 61 | | | | | |
| Tuolumne | 8,159 | | 749 | 308 | | | | | |
| Yuba | 1,003 | | 5,779 | 4,002 | | | | | |
| | 1,412,810 | 969,445 | 232,113 | 891,087 | 2,775 | 18,734 | 574,890 | 81,300 | 222,700 |
| Total, 1937 | 952,132 | 1,219,326 | 176,292 | 724,360 | 2,604 | 6,931 | 149,604 | 89,800 | 238,500 |
| Grand total: 1938 | 3,946,459 | 983,955 | 569,627 | 955,017 | 20,744 | 102,845 | 937,529 | 149,900 | 318,900 |
| 1937 | 3,335,284 | 1,279,078 | 546,296 | 938,999 | 22,943 | 89,192 | 460,984 | 172,700 | 375,900 |

[1] Ore figures include sands, slimes, and concentrates cyanided.

*Mine production of metals from concentrating mills in California in 1938, by counties, in terms of recovered metals*

| County | Material treated | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Amador | 90 | | 11 | 27 | 14 | | |
| Butte | 60 | | 6 | 30 | 7 | | |
| Calaveras | 700 | | 70 | 38 | 699 | 14,300 | |
| Eldorado | 85,116 | | 5,901 | 12,603 | 4,040 | 36,200 | 2,000 |
| Imperial | 54,155 | | 1,192 | 7,773 | 3,054 | 69,900 | |
| Inyo | 39,844 | | 1,699 | 9,006 | 7,549 | 51,100 | 69,100 |
| Kern | 36,479 | | 669 | 5,024 | 5,185 | | 3,800 |
| Los Angeles | 291 | | 30 | 274 | 338 | | |
| Mono | 2,270 | | 227 | 167 | 147,676 | 3,400 | |
| Napa | 4,020 | | 402 | 1,836 | 148,337 | 4,000 | |
| Nevada | 4,069 | | 117 | 1,003 | 469 | 700 | 5,100 |
| Plumas | 112,350 | | 4,848 | 11,298 | 51,729 | 1,197,100 | 900 |
| Riverside | 2,085 | 4,375 | 253 | 346 | 4,613 | 13,600 | 232,700 |
| San Bernardino | 3,114 | | 264 | 379 | 588 | 200 | 100 |
| Shasta | 390 | | 38 | 103 | 100 | | |
| Sierra | 5,030 | | 236 | 823 | 415 | | 8,000 |
| Tuolumne | 29,572 | | 1,195 | 5,087 | 2,113 | 1,000 | |
| | 379,635 | 4,375 | 17,158 | 55,817 | 376,926 | 1,391,500 | 321,700 |
| Total, 1937 | 667,208 | 5,469 | 31,293 | 58,138 | 963,165 | 10,107,000 | 96,500 |

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*Gross metal content of concentrates produced from ores mined in California in 1938, by classes of concentrates*

| Class of concentrates | Concentrates | Gross metal content | | | |
|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Dry gold | 33,005 | 145,258 | 951,030 | 322,278 | 373,259 |
| Dry gold-silver | 407 | 1,849 | 149,145 | 6,357 | ---------- |
| Dry silver | 220 | 126 | 147,642 | 4,429 | ---------- |
| Copper | 3,695 | 10,032 | 50,311 | 1,318,430 | 1,735 |
| Lead | 328 | 1,055 | 11,717 | 7,865 | 87,226 |
| Lead-copper | 247 | 342 | 4,610 | 18,616 | 242,246 |
| | 37,902 | 158,662 | 1,314,455 | 1,677,975 | 704,466 |
| Total, 1937 | 54,236 | 147,330 | 1,424,149 | 10,699,831 | 522,936 |

*Mine production of metals from California concentrates shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead |
|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Amador | 2,268 | 8,968 | 3,424 | 4,000 | ---------- |
| Butte | 194 | 2,081 | 5,446 | ---------- | ---------- |
| Calaveras | 2,943 | 11,872 | 5,926 | 19,900 | 2,000 |
| Eldorado | 7,248 | 18,346 | 5,109 | 42,000 | 2,000 |
| Imperial | 1,192 | 7,773 | 3,054 | 69,900 | ---------- |
| Inyo | 1,711 | 9,076 | 7,827 | 51,100 | 69,100 |
| Kern | 897 | 18,000 | 535,740 | ---------- | 4,000 |
| Los Angeles | 212 | 1,177 | 1,095 | 2,000 | ---------- |
| Mariposa | 2,078 | 11,921 | 3,744 | 4,000 | ---------- |
| Modoc | 1 | 3 | 10 | ---------- | ---------- |
| Mono | 229 | 172 | 147,697 | 3,400 | ---------- |
| Monterey | 4 | 37 | 2 | ---------- | ---------- |
| Napa | 402 | 1,836 | 148,337 | 4,000 | ---------- |
| Nevada | 9,407 | 38,477 | 345,597 | 123,600 | 295,500 |
| Placer | 755 | 3,537 | 31,645 | 4,300 | 16,000 |
| Plumas | 4,929 | 12,802 | 51,996 | 1,197,100 | 900 |
| Riverside | 281 | 459 | 4,650 | 13,600 | 232,700 |
| San Bernardino | 300 | 1,057 | 7,632 | 500 | 9,000 |
| Shasta | 174 | 1,409 | 637 | ---------- | 1,400 |
| Sierra | 604 | 2,254 | 909 | ---------- | 8,000 |
| Siskiyou | 179 | 386 | 62 | ---------- | ---------- |
| Trinity | 3 | 32 | 22 | ---------- | ---------- |
| Tuolumne | 1,887 | 6,972 | 3,891 | 2,000 | ---------- |
| Ventura | 1 | 1 | 1 | ---------- | ---------- |
| Yuba | 3 | 14 | 2 | ---------- | ---------- |
| | 37,902 | 158,662 | 1,314,455 | 1,541,400 | 640,600 |
| Total, 1937 | 54,236 | 147,330 | 1,424,149 | 10,279,700 | 472,400 |

BY CLASSES OF CONCENTRATES

| | | | | | |
|---|---|---|---|---|---|
| Dry gold | 33,005 | 145,258 | 951,030 | 235,900 | 323,900 |
| Dry gold-silver | 407 | 1,849 | 149,145 | 4,000 | ---------- |
| Dry silver | 220 | 126 | 147,642 | 3,400 | ---------- |
| Copper | 3,695 | 10,032 | 50,311 | 1,278,300 | 900 |
| Lead | 328 | 1,055 | 11,717 | 6,200 | 83,100 |
| Lead-copper | 247 | 342 | 4,610 | 13,600 | 232,700 |
| | 37,902 | 158,662 | 1,314,455 | 1,541,400 | 640,600 |

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*Gross metal content of California crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 5,618 | 8,178 | 18,586 | 26,494 | 7,310 | |
| Dry and siliceous gold-silver | 5,987 | 1,638 | 224,932 | 17,712 | | |
| Dry and siliceous silver | 173 | 3 | 9,069 | 973 | 4,419 | |
| Copper | 121 | 68 | 128 | 22,480 | 2,394 | |
| Lead | 851 | 440 | 18,829 | 11,680 | 354,323 | |
| | 12,750 | 10,327 | 271,544 | 79,339 | 368,446 | |
| Total, 1937 | 23,785 | 8,646 | 484,636 | 244,001 | 1,994,370 | 43,588 |

*Mine production of metals from California crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Alpine | 1 | 1 | 167 | | | |
| Amador | 44 | 116 | 58 | | | |
| Butte | 16 | 16 | 3 | | | |
| Calaveras | 376 | 564 | 518 | 100 | | |
| Eldorado | 42 | 31 | 18 | | | |
| Imperial | 302 | 120 | 51 | 100 | | |
| Inyo | 1,685 | 890 | 16,795 | 10,900 | 322,900 | |
| Kern | 93 | 114 | 1,408 | | | |
| Lassen | 1 | 1 | 27 | | | |
| Los Angeles | 3 | 1 | 2 | | | |
| Mariposa | 8 | 10 | 16 | | | |
| Mono | 20 | 1 | 6,193 | 600 | 4,000 | |
| Nevada | 82 | 3,567 | 11,552 | 400 | 500 | |
| Orange | 4 | 1 | 679 | | 2,000 | |
| Placer | 461 | 616 | 823 | 1,700 | | |
| Plumas | 432 | 274 | 860 | 6,900 | 1,100 | |
| Riverside | 75 | 75 | 91 | 400 | 1,300 | |
| Sacramento | 1 | 3 | 2 | | | |
| San Bernardino | 8,776 | 2,678 | 231,913 | 43,500 | 17,000 | |
| San Diego | 30 | 28 | 12 | 6,000 | | |
| Shasta | 183 | 1,034 | 267 | | 600 | |
| Sierra | 1 | 3 | | | | |
| Siskiyou | 11 | 13 | 11 | | | |
| Trinity | 4 | 66 | 18 | | | |
| Tulare | 5 | 2 | 8 | | | |
| Tuolumne | 88 | 98 | 48 | | | |
| Yuba | 6 | 4 | 4 | | | |
| | 12,750 | 10,327 | 271,544 | 70,600 | 349,400 | |
| Total, 1937 | 23,785 | 8,646 | 484,636 | 222,300 | 1,899,600 | 40,000 |

BY CLASSES OF ORE

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry and siliceous gold | 5,618 | 8,178 | 18,586 | 24,400 | 6,900 | |
| Dry and siliceous gold-silver | 5,987 | 1,638 | 224,932 | 16,800 | | |
| Dry and siliceous silver | 173 | 3 | 9,069 | 900 | 3,300 | |
| Copper | 121 | 68 | 128 | 20,400 | 500 | |
| Lead | 851 | 440 | 18,829 | 8,100 | 338,700 | |
| | 12,750 | 10,327 | 271,544 | 70,600 | 349,400 | |

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, and lead in California in 1938, by counties and districts, in terms of recovered metals* [1]

| County and district [1] | Mines producing [2] | | Ore and old tailings | Gold | | | Silver (lode and placer) [3] | Copper | Lead | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | |
| Alpine County: Monitor | 1 | | 1 | 1 | | 1 | 167 | | | $143 |
| Amador County: | | | | | | | | | | |
| East Belt [4] | 11 | 7 | 10,425 | 1,221 | 1,591 | 2,812 | 2,161 | 1,300 | | 99,944 |
| Ione | | 9 | | | 26,453 | 26,453 | 2,965 | | | 927,772 |
| Mother Lode [5] | 32 | 11 | 725,652 | 69,089 | 3,962 | 73,051 | 16,966 | 2,700 | | 2,568,018 |
| Butte County: | | | | | | | | | | |
| Butte Creek | (6) | 5 | (6) | (6) | 1,506 | [8] 1,506 | [8] 155 | | | 52,810 |
| Cherokee | 1 | | 9 | 3 | | 3 | 1 | | | 106 |
| Enterprise | | 1 | | | 9 | 9 | 1 | | | 316 |
| Forbestown | (6) | (7) | (6) | (6) | 20 | [8] 20 | [8] 2 | | | [8] 701 |
| Golden Summit | | 1 | | | 3,002 | 3,002 | 120 | | | 105,148 |
| Inskip | 1 | | 110 | 7 | | 7 | 2 | | | 246 |
| Magalia | 1 | 7 | 487 | 61 | 1,391 | 1,452 | 196 | | | 50,947 |
| Merrimac | 1 | 2 | 170 | 108 | 6 | 114 | 46 | | | 4,020 |
| Oroville | 5 | 18 | 565 | 82 | 33,931 | 34,013 | 2,388 | | | 1,191,999 |
| Paradise | | 1 | | | 3 | 3 | 1 | | | 106 |
| Stirling City | 1 | (6) | 18 | 3 | (6) | [9] 3 | [9] 1 | | | [9] 106 |
| Yankee Hill | 5 | 1 | 24,437 | 4,991 | 6 | 4,997 | 9,002 | | | 180,714 |
| Calaveras County: | | | | | | | | | | |
| Camanche [10] | | 10 | | | 12,660 | 12,660 | 1,092 | | | 443,806 |
| Campo Seco | 2 | 8 | 312 | 9 | 2,352 | 2,361 | 651 | 11,400 | | 84,173 |
| Copperopolis | 7 | (7) | 41,463 | 4,835 | 47 | 4,882 | 4,038 | 1,000 | | 173,578 |
| East Belt [4] | 21 | 3 | 48,093 | 14,410 | 203 | 14,613 | 2,275 | 2,600 | | 513,181 |
| Jenny Lind | 5 | 5 | 734 | 92 | 10,578 | 10,670 | 625 | 2,900 | | 374,138 |
| Mother Lode [5] | 20 | 24 | 429,450 | 31,044 | 6,805 | 37,849 | 8,970 | 2,100 | 2,000 | 1,330,812 |
| Del Norte County: | | | | | | | | | | |
| French Hill | | 2 | | | 16 | 16 | 1 | | | 560 |
| Monumental | | 1 | | | 4 | 4 | 1 | | | 141 |
| Eldorado County: | | | | | | | | | | |
| East Belt [4] | 8 | 4 | 1,030 | 577 | 317 | 894 | 344 | | | 31,512 |
| Mother Lode [5] | 51 | 25 | 66,085 | 20,901 | 1,508 | 22,409 | 3,211 | 5,400 | | 786,920 |
| West Belt | 12 | 4 | 105,409 | 15,475 | 3,645 | 19,120 | 5,289 | 36,600 | 2,000 | 676,298 |

See footnotes at end of table.

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*Mine production of gold, silver, copper, and lead in California in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore and old tailings | Gold | | | Silver (lode and placer) | Copper | Lead | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | |
| Fresno County: | | | | | | | | | | |
| Copper King | 1 | | 8 | 14 | | 14 | | | | $490 |
| Friant | | 2 | | | 284 | 284 | 49 | | | 9,972 |
| Mill Creek | 1 | | 6 | 3 | | 3 | | | | 105 |
| Sycamore | | 1 | | | 2 | 2 | | | | 70 |
| Temperance Flat | 1 | | 15 | 10 | | 10 | 5 | | | 353 |
| Humboldt County: | | | | | | | | | | |
| Gold Bluff | | 1 | | | 11 | 11 | | | | 385 |
| Orleans | 1 | 5 | 35 | 19 | 528 | 547 | 85 | | | 19,200 |
| Trinity River | | 4 | | | 37 | 37 | 4 | | | 1,298 |
| Imperial County: | | | | | | | | | | |
| Cargo Muchacho | 13 | 2 | 73,671 | 12,772 | 6 | 12,778 | 4,322 | 70,000 | | 456,884 |
| Mesquite | 1 | (7) | 1 | 6 | 13 | 19 | 3 | | | 667 |
| Picacho | 1 | 2 | 32 | 13 | 4 | 17 | 6 | | | 599 |
| Inyo County: | | | | | | | | | | |
| Carbonate | 6 | | 1,130 | 509 | | 509 | 2,685 | 5,200 | 57,100 | 22,687 |
| Casa Diablo | 1 | | 24 | 17 | | 17 | 20 | | | 608 |
| Cerro Gordo | 7 | | 6,961 | 750 | | 750 | 9,312 | 300 | 24,500 | 33,426 |
| Chidago [11] | 1 | | 36,468 | 8,580 | | 8,580 | 2,485 | 45,700 | | 306,385 |
| Chloride Cliff | 4 | | 83 | 53 | | 53 | 146 | | 2,000 | 2,041 |
| Coso | 16 | 2 | 1,904 | 210 | 65 | 275 | 1,199 | | | 10,400 |
| Darwin | 5 | | 1,550 | 24 | | 24 | 7,228 | 1,800 | 137,200 | 12,000 |
| Echo Canyon | 1 | | 1,500 | 309 | | 309 | 37 | | | 10,839 |
| Fish Springs | 5 | | 452 | 105 | | 105 | 53 | | | 3,709 |
| Furnace Creek | 1 | | 24 | 20 | | 20 | | | | 700 |
| Kearsarge | 1 | | 3 | 1 | | 1 | 15 | | | 45 |
| Marble Canyon | | 7 | | | 63 | 63 | 4 | | | 2,208 |
| Mt. Argus | 2 | | 2,463 | 439 | | 439 | 23 | | | 15,380 |
| Russ | 6 | | 197 | 21 | | 21 | 4,178 | 600 | 3,100 | 3,637 |
| Sherwin | 1 | | 40 | 17 | | 17 | 71 | | | 641 |
| South Park | 8 | | 18,940 | 4,540 | | 4,540 | 448 | 2,300 | 1,000 | 159,461 |
| Ubehebe | 4 | | 156 | 21 | | 21 | 1,188 | | | 1,503 |
| Union | 1 | | 1,504 | 1,201 | | 1,201 | 5,912 | 700 | 73,100 | 49,288 |
| White Mountain | 1 | | 66 | 76 | | 76 | 31 | | | 2,680 |
| Wild Rose | 8 | | 1,500 | 345 | | 345 | 1,611 | | 24,900 | 14,262 |
| Kern County: | | | | | | | | | | |
| Agua Caliente | 4 | | 2,332 | 226 | | 226 | 108 | | | 7,980 |
| China Grade | | 1 | | | 72 | 72 | 13 | | | 2,528 |
| Cove | 2 | | 38,410 | 4,943 | | 4,943 | 4,915 | | 4,000 | 176,366 |
| Goler | | 2 | | | 75 | 75 | 20 | | | 2,638 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Greenhorn | 1 | | 4 | 1 | | 1 | 1 | | | | | 36 |
| Green Mountain | 7 | | 850 | 304 | | 304 | 170 | | | | | 10,750 |
| Havilah | 10 | 1 | 874 | 198 | 1 | 199 | 195 | | | | | 7,091 |
| Long Tom | 2 | 1 | 110 | 54 | 3 | 57 | 23 | | | | | 2,010 |
| Mojave | 34 | | 219,326 | 61,933 | | 61,933 | 1,135,659 | | | | | 2,901,819 |
| Pioneer | 12 | 1 | 677 | 113 | 2 | 115 | 128 | | | | | 4,108 |
| Rademacher | 7 | | 176 | 125 | | 125 | 156 | | | | | 4,476 |
| Randsburg [12] | 39 | 3 | 582,211 | 17,031 | 1,248 | 18,279 | 5,266 | | | | | 643,169 |
| Red Rock | 2 | | 1,434 | 76 | | 76 | 1,464 | | | | | 3,606 |
| Sageland | 6 | (7) | 103 | 39 | 27 | 66 | 36 | | | | | 2,333 |
| Tehachapi | 2 | 1 | 95 | 29 | 2 | 31 | 8 | | | | | 1,060 |
| Woody | | 1 | | 201 | | 201 | 15 | | | | | 7,045 |
| Lassen County: | | | | | | | | | | | | |
| Hayden Hill | 1 | | 1 | 1 | | 1 | 27 | | | | | 52 |
| Honey Lake | 1 | 1 | 4 | 2 | 3 | 5 | 1 | | | | | 176 |
| Los Angeles County: | | | | | | | | | | | | |
| Cedar | 4 | | 12,228 | 4,216 | | 4,216 | 1,475 | 2,000 | | | | 148,710 |
| Neenach | 3 | | 284 | 271 | | 271 | 336 | | | | | 9,702 |
| San Gabriel | 2 | 5 | 57 | 5 | 386 | 391 | 70 | | | | | 13,730 |
| Saugus | 2 | 5 | 8 | 3 | 11 | 14 | 2 | | | | | 491 |
| Valyermo | 1 | | 175 | 14 | | 14 | 4 | | | | | 493 |
| Madera County: | | | | | | | | | | | | |
| Hildreth | 3 | 4 | 11 | 6 | 26 | 32 | 14 | | | | | 1,129 |
| Potter Ridge | 11 | 9 | 436 | 70 | 162 | 232 | 70 | | | | | 8,165 |
| Mariposa County: | | | | | | | | | | | | |
| Colorado | 5 | 1 | 689 | 518 | 1 | 519 | 90 | | | | | 18,223 |
| Hites Cove | 1 | | 617 | 48 | | 48 | 15 | | | | | 1,690 |
| Hunter Valley | 11 | (6) | 11,657 | 8,151 | (6) | [9] 8,151 | [9] 2,858 | 2,200 | | | | [9] 287,348 |
| Mother Lode [8] | 45 | 14 | 74,373 | 12,089 | 7,404 | 19,493 | 4,517 | 1,800 | | | | 685,351 |
| Whitlock | 8 | | 16,267 | 2,691 | | 2,691 | 493 | | | | | 94,504 |
| Merced County: Snelling | | 5 | | 59,724 | | 59,724 | 5,859 | | | | | 2,094,128 |
| Modoc County: High Grade | 1 | | 400 | 23 | | 23 | 24 | | | | | 821 |
| Mono County: | | | | | | | | | | | | |
| Bodie | 5 | | 66,679 | 2,305 | | 2,305 | 66,701 | | | | | 123,795 |
| Chidago [11] | 6 | | 197 | 55 | | 55 | 49 | | | | | 1,957 |
| Dunderberg | 1 | | 30 | 5 | | 5 | 2 | | | | | 176 |
| Masonic | 2 | | 980 | 200 | | 200 | 185 | | | | | 7,120 |
| Mono Lake | 1 | | 1 | 1 | | 1 | | | | | | 35 |
| Mount Patterson | 1 | | 2,200 | 126 | | 126 | 147,642 | 3,400 | | | | 100,189 |
| Piute | 1 | | 30 | 3 | | 3 | 1 | | | | | 106 |
| White Mountains | 1 | | 20 | 1 | | 1 | 6,193 | 600 | 4,000 | | | 4,281 |
| Monterey County: Los Burros | 1 | 1 | 120 | 57 | 4 | 61 | 5 | | | | | 2,138 |
| Napa County: Calistoga | 1 | | 4,020 | 1,836 | | 1,836 | 148,337 | 4,000 | | | | 160,547 |
| Nevada County: | | | | | | | | | | | | |
| French Corral | | 3 | | 553 | | 553 | 60 | | | | | 19,394 |
| Grass Valley-Nevada City | 23 | 10 | 1,040,079 | 296,132 | 13,753 | 309,885 | 459,317 | 42,700 | 73,300 | | | 11,150,463 |
| North San Juan | | 2 | | | | 7 | | | | | | 245 |
| Washington | 7 | 7 | 23,624 | 4,601 | 6,101 | 10,702 | 45,710 | 81,300 | 222,700 | | | 422,331 |
| You Bet | | 7 | | 611 | | 611 | 69 | | | | | 21,430 |

See footnotes at end of table.



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*Mine production of gold, silver, copper, and lead in California in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore and old tailings | Gold | | | Silver (lode and placer) | Copper | Lead | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | |
| Orange County: | | | | | | | | | | |
| San Juan Capistrano | | 1 | | | 6 | 6 | 3 | | | $212 |
| Santa Rosa | 1 | | 4 | 1 | | 1 | 679 | | 2,000 | 566 |
| Placer County: | | | | | | | | | | |
| Auburn | 4 | 2 | 468 | 165 | 3,445 | 3,610 | 545 | | | 126,702 |
| Butcher Ranch | (6) | 2 | (6) | (6) | 17 | [8] 17 | [8] 3 | | | [8] 597 |
| Colfax | 1 | (7) | 2,646 | 194 | 8 | 202 | 34 | | | 7,092 |
| Damascus | | 1 | | | 101 | 101 | 5 | | | 3,538 |
| Dutch Flat | (6) | 2 | (6) | (6) | 496 | [8] 496 | [8] 47 | | | [8] 17,390 |
| Foresthill | 6 | 4 | 1,038 | 264 | 448 | 712 | 96 | | | 24,982 |
| Iowa Hill | | 13 | | | 898 | 898 | 103 | | | 31,497 |
| Last Chance | 1 | 7 | 126 | 21 | 194 | 215 | 27 | | | 7,542 |
| Lincoln | | 9 | | | 9,752 | 9,752 | 1,648 | | | 342,385 |
| Michigan Bluff | | 5 | | | 118 | 118 | 10 | | | 4,136 |
| Ophir | 11 | 20 | 82,713 | 15,124 | 16,320 | 31,444 | 40,144 | 6,000 | 16,000 | 1,127,816 |
| Plumas County: | | | | | | | | | | |
| Bucks Lake | 1 | | 50 | 30 | | 30 | 7 | | | 1,055 |
| Butte Valley | 2 | | 258 | 38 | | 38 | 3,750 | | 900 | 3,796 |
| Clear Creek | 1 | | 10 | 1 | | 1 | 1 | | | 36 |
| Crescent Mills | 6 | 9 | 32,228 | 3,956 | 741 | 4,697 | 1,196 | 6,900 | | 165,844 |
| Granite Basin | 1 | 1 | 30 | 24 | 462 | 486 | 71 | | 100 | 17,060 |
| Johnsville | 4 | 2 | 445 | 256 | 116 | 372 | 160 | | 1,000 | 13,169 |
| La Porte | 1 | 5 | 216 | 30 | 963 | 993 | 87 | | | 34,811 |
| Lights Canyon | | 1 | | | 65 | 65 | 10 | | | 2,281 |
| Quincy | 4 | 10 | 3,557 | 517 | 535 | 1,052 | 124 | | | 36,900 |
| Rich Bar | (6) | 4 | (6) | (6) | 779 | [8] 779 | [8] 81 | | | [8] 27,317 |
| Seneca | 1 | | 40 | 20 | | 20 | 3 | | | 702 |
| Wolf Creek | 2 | (6) | 747 | 157 | (6) | [9] 157 | [9] 38 | | | [9] 5,520 |
| Riverside County: | | | | | | | | | | |
| Chuckawalla | 3 | (7) | 2,215 | 454 | 31 | 485 | 202 | 200 | 300 | 17,139 |
| Dale [13] | 8 | (6) | 678 | 210 | (6) | [9] 210 | [9] 75 | | | [9] 7,398 |
| Eagle Mountain | 3 | 1 | 6,468 | 363 | 5 | 368 | 4,643 | 13,800 | 233,700 | 27,984 |
| Ironwood | 2 | | 430 | 118 | | 118 | | | | 4,130 |
| Morongo [14] | 1 | | 4 | 7 | | 7 | | | | 245 |
| Mt. Beauty | 1 | | 120 | 2 | | 2 | 1 | | | 71 |
| Pinacate | 3 | 2 | 1,300 | 870 | 69 | 939 | 275 | | | 33,043 |
| Pinon | 4 | | 194 | 68 | | 68 | 41 | | | 2,407 |
| Sacramento County: | | | | | | | | | | |
| Cosumnes River | | 3 | | | 17,088 | 17,088 | 1,046 | | | 598,755 |
| Folsom | 1 | 11 | 1 | 3 | 124,885 | 124,888 | 5,169 | | | 4,374,422 |

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|---|---|---|---|---|---|---|---|---|---|---|
| Michigan Bar | | 1 | | | 1 | 1 | | | | 35 |
| Wall Town | 1 | | 1 | 127 | | 127 | 21 | | | 4,459 |
| San Bernardino County: | | | | | | | | | | |
| Black Hawk | 1 | | 1 | 1 | | 1 | 3 | | | 37 |
| Buckeye | 3 | | 1,523 | 374 | | 374 | 1,850 | 18,000 | 200 | 16,059 |
| Calico | 7 | | 7,278 | 16 | | 16 | 11,477 | | 1,000 | 8,025 |
| Coolgardie | | (7) | | | 4 | 4 | | | | 140 |
| Dale [13] | 6 | | 13,946 | 6,087 | | 6,087 | 11,865 | 500 | 8,900 | 221,174 |
| Dry Lake | 3 | | 984 | 199 | | 199 | 54 | | | 7,000 |
| Fremont Peak | 1 | | 639 | 43 | | 43 | 8 | | | 1,510 |
| Goldstone | 10 | (7) | 366 | 185 | 3 | 188 | 198 | | | 6,708 |
| Grapevine | 1 | | 5 | | | | 6 | 700 | | 72 |
| Halloran Springs | 5 | 1 | 1,963 | 614 | 3 | 617 | 597 | 700 | | 22,050 |
| Hikorum | 1 | | 4 32 | 5 | | 5 | 25 | 4,100 | | 593 |
| Holcomb Valley | | 5 | | | 181 | 181 | 24 | | | 6,351 |
| Ibex | 1 | | 2 | 5 | | 5 | 1 | | | 176 |
| Ivanpah | 6 | | 2,970 | 277 | | 277 | 4,099 | 300 | 200 | 12,383 |
| Kelso | 1 | | 25 | 9 | | 9 | 34 | | | 337 |
| Kingston Mountain | 1 | | 45 | 4 | | 4 | 138 | | 15,300 | 933 |
| Kramer Hills | 1 | | 15 | 7 | | 7 | 2 | | | 246 |
| Morongo [14] | 2 | | 86 | 6 | | 6 | | | | 210 |
| Myrick | 1 | | 45 | 4 | | 4 | 1 | | | 141 |
| Needles | 3 | | 59 | 14 | | 14 | | | | 490 |
| Old Woman Mountain | 4 | | 3,332 | 790 | | 790 | 144 | 100 | | 27,753 |
| Ord Mountain | 1 | | 70 | 64 | | 64 | 28 | 400 | | 2,297 |
| Paradise | | 1 | | | 3 | 3 | | | | 105 |
| Providence | 3 | | 36 | 5 | | 5 | 201 | | | 305 |
| Randsburg [12] | 8 | 4 | 6,303 | 1,714 | 580 | 2,294 | 224,871 | 16,800 | | 227,308 |
| Shadow Mountains | 1 | | 200 | 3 | | 3 | 2 | | | 106 |
| Signal | 2 | | 19 | 56 | | 56 | 12 | | | 1,968 |
| Silver Mountain | 8 | | 457 | 255 | | 255 | 1,318 | | 200 | 9,786 |
| Slate Range | 2 | | 58 | 24 | | 24 | 157 | | 100 | 946 |
| Turtle Mountain | 4 | | 263 | 113 | | 113 | 51 | 500 | | 4,037 |
| Vanderbilt | 2 | | 4 | 3 | | 3 | 200 | | 100 | 239 |
| Whipple Mountain | 3 | | 57 | 35 | | 35 | 3 | 1,600 | | 1,384 |
| San Diego County: | | | | | | | | | | |
| Ballena | | 1 | | | 1 | 1 | | | | 35 |
| De Luz | 1 | | 20 | 4 | | 4 | 2 | | | 141 |
| Julian | 3 | 1 | 103 | 43 | 3 | 46 | 14 | 6,000 | | 2,207 |
| Ramona | | 1 | | | 2 | 2 | | | | 70 |
| San Francisco County: San Francisco | | (7) | | | 74 | 74 | 5 | | | 2,593 |
| San Joaquin County: | | | | | | | | | | |
| Camanche [10] | | 1 | | | 18 | 18 | 3 | | | 632 |
| Linden | | 1 | | | 329 | 329 | 22 | | | 11,529 |
| Wallace | | (7) | | | 841 | 841 | 67 | | | 29,478 |
| San Luis Obispo County: Oro Fino | | 1 | | | 215 | 215 | 5 | | | 7,528 |
| Santa Clara County: Lexington | 1 | | 1 | 1 | | 1 | 1 | | | 36 |
| Santa Cruz County: Santa Cruz | | (7) | | | 10 | 10 | 2 | | | 351 |

See footnotes at end of table.

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*Mine production of gold, silver, copper, and lead in California in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore and old tailings | Gold | | | Silver (lode and placer) | Copper | Lead | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | |
| Shasta County: | | | | | | | | | | |
| Centerville | (6) | 3 | (6) | (6) | 35 | [3] 35 | [3] 2 | | | [3] $1,226 |
| French Gulch | 14 | 6 | 6,180 | 2,856 | 594 | 3,450 | 782 | | 2,000 | 121,348 |
| Igo | 3 | 18 | 36 | 14 | 18,777 | 18,791 | 1,315 | | | 658,535 |
| Redding | 1 | 3 | 3,000 | 1,528 | 26 | 1,554 | 441 | | | 54,675 |
| Shasta | 8 | 4 | 1,126 | 653 | 146 | 799 | 239 | | | 28,120 |
| Sierra County: | | | | | | | | | | |
| Alleghany | 9 | 12 | 51,263 | 19,261 | 3,304 | 22,565 | 4,112 | | | 792,433 |
| Brandy City | | 1 | | | 12 | 12 | 2 | | | 421 |
| Downieville | 5 | 15 | 5,934 | 911 | 1,044 | 1,955 | 556 | | 8,000 | 69,152 |
| Gold Lake | | 1 | | | 6 | 6 | 1 | | | 211 |
| Pike | 1 | 3 | 120 | 182 | 29 | 211 | 54 | | | 7,420 |
| Poker Flat | | 1 | | | 29 | 29 | 3 | | | 1,017 |
| Port Wine | | 2 | | | 54 | 54 | 3 | | | 1,892 |
| Sierra City | 5 | 2 | 1,910 | 635 | 29 | 664 | 60 | | | 23,279 |
| Siskiyou County: | | | | | | | | | | |
| Callahan | 2 | 7 | 100 | 25 | 10,622 | 10,647 | 1,397 | | | 373,548 |
| Greenhorn | (6) | 5 | (6) | (6) | 14,535 | [3] 14,535 | [3] 2,155 | | | [3] 510,118 |
| Humbug | 2 | 3 | 155 | 13 | 706 | 719 | 119 | | | 25,242 |
| Klamath River | 12 | 30 | 2,404 | 259 | 3,329 | 3,588 | 565 | | | 125,945 |
| Liberty | 5 | 22 | 81,720 | 4,422 | 1,372 | 5,794 | 602 | | | 203,179 |
| Salmon River | 4 | 6 | 435 | 237 | 689 | 926 | 146 | | | 32,504 |
| Scott River | 11 | 7 | 457 | 304 | 439 | 743 | 169 | | | 26,114 |
| Stanislaus County: | | | | | | | | | | |
| Knights Ferry | | 3 | | | 1,268 | 1,268 | 122 | | | 44,459 |
| Waterford | | 1 | | | 20 | 20 | 2 | | | 701 |
| Tehama County: Red Bluff | | 1 | | | 2,112 | 2,112 | 161 | | | 74,024 |
| Trinity County: | | | | | | | | | | |
| Big Bar | 1 | 5 | 26 | 20 | 949 | 969 | 119 | | | 33,992 |
| Coffee Creek | 4 | 3 | 220 | 55 | 272 | 327 | 46 | | | 11,475 |
| Hayfork | 2 | 4 | 20 | 84 | 3,473 | 3,557 | 567 | | | 124,862 |
| Helena | 1 | 1 | 397 | 262 | 158 | 420 | 95 | | | 14,761 |
| Junction City | 3 | 8 | 44 | 8 | 10,252 | 10,260 | 1,018 | | | 359,758 |
| Lewiston | 6 | 5 | 2,502 | 309 | 7,308 | 7,617 | 1,129 | | | 267,325 |
| New River | 4 | 8 | 723 | 244 | 251 | 495 | 61 | | | 17,364 |
| Salyer | | 8 | | | 378 | 378 | 38 | | | 13,255 |
| Trinity Center | 1 | 4 | 1 | 6 | 56 | 62 | 8 | | | 2,175 |
| Weaverville | 2 | 18 | 53 | 32 | 17,350 | 17,382 | 1,547 | | | 609,370 |

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|---|---|---|---|---|---|---|---|---|---|---|
| Tulare County: | | | | | | | | | | |
| Bear Mountain | 1 | | 50 | 2 | | 2 | | | | 70 |
| Porterville | 1 | | 10 | 3 | | 3 | 2 | | | 106 |
| White River | 3 | 2 | 18 | 10 | 25 | 35 | 17 | | | 1,236 |
| Tuolumne County: | | | | | | | | | | |
| Columbia | 33 | 7 | 12,549 | 3,648 | 343 | 3,991 | 1,688 | 1,000 | | 140,874 |
| East Belt [4] | 7 | 1 | 26,741 | 3,395 | 103 | 3,498 | 820 | | | 122,960 |
| Mother Lode [5] | 16 | 13 | 58,932 | 6,489 | 10,436 | 16,925 | 4,521 | 1,000 | | 595,396 |
| Ventura County: Snowey | 1 | | 75 | 19 | | 19 | 5 | | | 668 |
| Yuba County: | | | | | | | | | | |
| Bear River | | 1 | | | 252 | 252 | 16 | | | 8,830 |
| Camptonville | 1 | 4 | 100 | 20 | 591 | 611 | 59 | | | 21,423 |
| Challenge | 2 | ([6]) | 1,833 | 336 | ([6]) | [9] 336 | [9] 47 | | | [9] 11,790 |
| Dobbins | 3 | 4 | 48 | 11 | 216 | 227 | 24 | | | 7,961 |
| Smartville | | 3 | | | 11,750 | 11,750 | 949 | | | 411,863 |
| Strawberry Valley | 1 | 8 | 1,448 | 48 | 156 | 204 | 23 | | | 7,155 |
| Combined districts [15] | 21 | 20 | 505,753 | 46,849 | 67,802 | 114,651 | 107,068 | 1,202,800 | 69,100 | 4,203,056 |
| Total California | 927 | 676 | 4,648,249 | 738,616 | 572,513 | 1,311,129 | 2,590,804 | 1,612,000 | 990,000 | 47,767,894 |

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures.
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of total silver as follows: 2,541,016 fine ounces from lode mines and 49,788 fine ounces from placers.
[4] East Belt district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[5] Mother Lode district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[6] Included under "Combined districts."
[7] Not reported.
[8] Exclusive of lode output, which is included under "Combined districts."
[9] Exclusive of placer output, which is included under "Combined districts."
[10] Camanche district lies in Amador, Calaveras, and San Joaquin Counties.
[11] Chidago district lies in Inyo and Mono Counties.
[12] Randsburg district lies in Kern and San Bernardino Counties.
[13] Dale district lies in Riverside and San Bernardino Counties.
[14] Morongo district lies in Riverside and San Bernardino Counties.
[15] Includes following districts: Camanche in Amador County; Butte Creek (lode), Centerville, Forbestown (lode), and Stirling City (placer) in Butte County; Sherman and Slate Range in Inyo County; Kaiser Creek in Madera County; Hunter Valley (placer) in Mariposa County; Dog Creek and May Lundy in Mono County; Butcher Ranch (lode), Canada Hill, and Dutch Flat (lode) in Placer County; Genesee, Rich Bar (lode), and Wolf Creek (placer) in Plumas County; Dale (placer) in Riverside County; Monumental in San Bernardino County; Pine Valley in San Diego County; Centerville (lode), Iron Mountain, North Cow Creek, and Old Diggings, in Shasta County; Depot Hill, in Sierra County; Greenhorn (lode) in Siskiyou County; La Grange in Stanislaus County; and Browns Valley, Challenge (placer), and Yuba River in Yuba County.

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## AMADOR COUNTY

*East Belt district.*—The Wiljobar Corporation worked the Defender mine in the East Belt district during 1938. The Fort Ann mine was one of the larger producers of gold ore in the district. The A. E. Kent Dredging Co. operated a dragline dredge on South Sutter Creek near Volcano.

*Ione district.*—The Arroyo Seco Gold Dredging Co. dredged 2,212,565 cubic yards of gravel on Dry Creek 3 miles west of Ione and recovered 12,091 ounces of gold; the company operated one dredge equipped with eighty-six 6-cubic foot buckets throughout 1938 and another dredge with sixty-five 2½-cubic foot buckets during January and February. E. L. Lilly started operations with a dragline dredge October 7. The Humphreys Gold Corporation began operations with a dragline dredge January 28 and continued throughout the rest of the year; the company used three electrically powered dragline excavators and an electrically powered floating washer. The Rim Cam Gold Dredging Co. operated a dragline dredge on Dry Creek 6 miles north of Ione. The Horton mine near Buena Vista treated 30,000 cubic yards of gravel by hydraulicking and recovered 548 ounces of gold.

*Mother Lode district.*—The Argonaut Mining Co., Ltd., in the Mother Lode district near Jackson was on a production status in 1938 from January 1 to February 15 and from July 16 to the end of the year; an underground fire caused the suspension of output. Gold ore was treated by amalgamation in the company 300-ton ball mill and flotation plant, and the concentrates were shipped for smelting. The Central Eureka Mining Co. worked the Central Eureka and Old Eureka mines throughout 1938. According to the company printed annual report for the year ended December 31, 1938, 49,253 tons of gold ore, largely from the Old Eureka, were milled. During the early months of the year the company shipped its concentrates for cyanide treatment elsewhere, but after additions to its metallurgical plant the company treated its concentrates and current tailings by cyanidation and flotation. The Central Tailings Co., which had worked in part on the current tailings from the Central Eureka mine, went out of business. Gold production at the Fremont Gover depended largely on mine dumps during the early months of the year, but after July the ore treated came entirely from underground mining. The Kennedy Mining & Milling Co. operated its mill on ore during the early months of 1938; production from treatment of the company's old tailings in its 1,000-ton cyanide plant was continuous. The Keystone Mine Syndicate treated 11,944 tons of ore from its property 3 miles north of Martell; the ore yielded 1,178 ounces of gold by amalgamation and smelting of flotation concentrates. The Delta Tailings Co. continued to cyanide, in its 600-ton plant, material derived from a deposit of old tailings collected as a delta on one of the streams draining the Mother Lode district. The R. & M. Mining Co. handled approximately 124,000 cubic yards of gravel and recovered 699 ounces of gold by dragline dredging on Indian Creek. The Lincoln Gold Dredging Co., River Pine Mining Co., and Wolin-Hall & Wackman operated dragline dredges in the district.

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## BUTTE COUNTY

*Butte Creek district.*—The Humphreys Gold Corporation began operations on the Fitts property with a dry-land dredge November 6, 1938, and continued work until the end of the year. The McLain drift mine was operated throughout 1938.

*Centerville district.*—A stationary washing plant, to which gravel was delivered by power shovels and trucks, was used in 1938 to treat gravel from the Hintz mine; operations were carried on from August 23 to December 16.

*Forbestown district.*—The Idaho Maryland Mines Corporation suspended work at the Forbestown group of properties November 30, 1938, after several years of production and an intensive exploration campaign. During the year 5,157 feet of development headings were driven and 1,612 feet of diamond drilling done. Ore from the mine was treated in a 300-ton amalgamation and flotation plant; the concentrates were shipped to the company cyanide plant at Grass Valley.

*Golden Summit district.*—The Table Mountain Dredging Co. began operations on Thompson's Flat with a dragline dredge April 22, 1938.

*Magalia district.*—A nonfloating washing plant on the Coleman property, to which gravel was delivered by mechanical excavation, was the most productive operation in the Magalia district in 1938.

*Oroville district.*—The Oroville district continued in 1938 to be one of the leading sources of placer gold in California; dredges of both the connected-bucket and dragline types were large producers. The Butte Gold Dredging Co. sold its dragline dredge (1½-cubic-yard dragline excavator) in April to Lord & Bishop, who continued the operation throughout the rest of the year. Consuelo Mines terminated production by its two dragline dredges early in the year. The Gold Hill Dredging Co. launched an electrically powered connected-bucket dredge, equipped with seventy-four 9-cubic-foot buckets, on the Kister Ranch early in 1938 and produced steadily until the end of the year. The Penn Dredging Co. moved its dragline dredge from Honcut Creek in Butte County to Nevada County after producing during the first 3 months of 1938. The connected-bucket dredge of the Oroville Gold Dredging Co. was damaged severely by floods in Feather River but resumed production before the end of 1938. William Richter operated a large dragline dredge throughout the year on land adjoining Feather River. Cinco Mineros Co. operated a 1½-cubic-yard dragline excavator and floating washing plant in the district.

*Yankee Hill district.*—The Surcease mine treated 23,987 tons of gold ore by cyanidation and flotation in 1938 and recovered 4,911 ounces of gold and 8,982 ounces of silver; the concentrates were shipped for smelting.

## CALAVERAS COUNTY[4]

*Camanche district.*—The Comanche Gold Dredging Co. operated its connected-bucket dredge during 1938 along Mokelumne River and dredged gravel in Amador, Calaveras, and San Joaquin Counties. Camanche Placers, Ltd., operated a dredge equipped with sixty-one 2½-cubic foot buckets at Camanche until May 23, when the work was suspended permanently. The Pacific Placers Engineering Co. oper-

[4] See also Julihn, C. E., and Horton, F. W., Mineral Industries Survey of the United States; California—Calaveras County, Mother Lode District (South): Bureau of Mines Bull. 413, 1938, 140 pp.

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ated a dry-bank washing plant on the Cook property west of Valley Springs from February until the end of the year. Lessees operated a dragline dredge on the K. D. Winship Estate property in the Camanche district until June 8. The Lancha Plana Gold Dredging Co. operated its dredge with eighty-four 6-cubic foot buckets throughout 1938 on its properties along Mokelumne River. E. L. Lilly discontinued dragline dredging between Camanche and Wallace August 9, after working from the first of the year. The Wallace Dredging Co. operated an electrically powered connected-bucket dredge with sixty 3-cubic foot buckets in Calaveras and San Joaquin Counties along Bear Creek near Wallace.

*Campo Seco district.*—The Pacific Placers Engineering Co. operated a dry-bank washing plant on the Robbins claims from June to the end of 1938.

*Copperopolis district.*—The Jumbo Consolidated Mining Co. treated a substantial tonnage of gold ore from the Mt. King mine in the Madam Felix section of the Copperopolis district during 1938; the company increased the daily capacity of its flotation mill to 195 tons. The Western Empire Mines Co., Ltd., worked the Royal mine in the same section of the Copperopolis district; the ore was treated by amalgamation and flotation, and the resulting concentrates were shipped to a smelter.

*East Belt district.*—The St. Joseph Lead Co. worked its Sheepranch mine from January 5 until the end of 1938, and the mine was by far the largest producer in the East Belt district. The S. O. S. Mining Co. closed the S. O. S. drift placer mine in October after recovering 58 ounces of gold from 2,200 cubic yards of gravel, mined by hoist and bucket.

*Jenny Lind district.*—The Milton Gold Dredging Enterprise operated its electrically powered dragline dredge on South Gulch near Milton throughout 1938. C. J. Thompson operated a small connected-bucket dredge with twenty-seven 1⅛-cubic foot buckets during the year; the gravel was cemented so tightly that a dragline excavator was used to work ahead of the dredge to loosen the gravel so that the bucket line could dig it.

*Mother Lode district.*—A development campaign with some production was carried on throughout 1938 at the Big Springs mine in the Mother Lode district. The Carson Hill Gold Mining Corporation treated 379,618 tons of ore at its Carson Hill mill at Melones in 1938—the largest tonnage of ore treated at any single mill in California. Only one company tonnage in the State exceeded it—that of the Empire Star Mines Co., Ltd., in the Grass Valley-Nevada City district of Nevada County. The Carson Hill 1,100-ton mill treated the ore by amalgamation and concentration, followed by regrinding of the concentrates and their return to the pulp circuit for cyanidation, and recovered 24,650 ounces of gold and 6,653 ounces of silver. The Le Roi Mines, Inc., operated the Easy (Easyz) Bird mine in the Mokelumne Hill section of the Mother Lode throughout 1938; in addition to production of a substantial tonnage of ore, 1,500 feet of development drifts were driven as part of the company development campaign. The Mother Lode Central Mines, Inc., closed down its Marble Springs and Bullion Quartz claims April 16, after operating from the first of the year. The dragline dredging operation of the Triangle

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Mining Co. southeast of San Andreas was taken over by the General Dredging Corporation November 8 and continued until the end of the year; equipment consisted of a floating washing plant and a dragline excavator with a 1¼-cubic yard bucket. A dragline dredge was operated from September 15 until the end of 1938 on Domingo Creek 3 miles north of Angels Camp. Another dragline dredge was operated from July 1 until September 10 on Chili Gulch. The San Andreas Dredging Co. worked a Diesel-powered dragline dredge in the San Andreas section of the Lode from August 20 until the end of 1938. The Universal Dredging Corporation operated a dragline excavator and a floating washer on Calaveras River from October 1 until the end of the year. The Vallecito Mining Co., Inc., operated the Vallecito Western drift mine on Six Mile Creek throughout 1938, mined 917 tons of gravel underground, and treated 27,223 cubic yards of old tailings.

### ELDORADO COUNTY

*East Belt district.*—The Middle End mine in the East Belt district of Eldorado County was operated in 1938 by Cosumnes Mines, Inc.; 950 tons of gold ore yielded 124 ounces of gold by amalgamation and 430 ounces of gold from the smelting of flotation concentrates.

*Mother Lode district.*—The Beebe Gold Mining Co. continued its operation of the Beebe mine in the Georgetown section of the Mother Lode throughout 1938 but suspended work at the Alpine mine before the end of the year; the ore was treated by flotation, and the concentrates were cyanided. Ore from the Black Oak mine, operated by R. J. Wilson throughout 1938, was treated by amalgamation and flotation, and the resulting concentrates were shipped to a smelter. The Kelsey Mining Co., Inc., conducted an exploration program at the Kelsey mine until July 1, when the Kelsey Mining Corporation took over the property; gold ore was produced throughout the year. The Lode Development Co. worked the Rozecrans mine in the Garden Valley section of the Lode throughout 1938 and recovered a substantial output of gold from the treatment of gold ore by amalgamation, flotation, and smelting of concentrates. The Middle Fork Gold Mining Co. worked the Sliger mine intermittently. The Horse Shoe Dredging Co. operated a dragline dredge on Buck's Bar on the North Fork of Cosumnes River from October 15 until the end of 1938.

*West Belt district.*—The Big Canyon mine in the Shingle Springs area of the West Belt district—the largest mining operation in Eldorado County—was worked by The Mountain Copper Co., Ltd., throughout 1938; the ore was treated by flotation, and the resulting concentrates were shipped to a smelter. Big Canyon Dredge (a dragline outfit) treated 760,000 cubic yards of gravel in Big Canyon Creek and recovered 3,476 ounces of gold. The Crystal mine 3 miles south of Shingle Springs was taken over by a new management in February 1938, and on October 5 the operating company was incorporated as the El Dorado Crystal Mine. During the early months of the year, a 100- to 125-ton all-slime, countercurrent decantation cyanide mill was built; milling of dump ore was begun July 12, but from September on the mill feed was entirely newly mined ore. Offices, a change house, an assay plant, and other structures were erected at the property, in addition to the mill.

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### FRESNO COUNTY

*Friant district.*—There were a number of small lode and placer operations in the Friant district in 1938. The largest production was made by the Grant Service Rock Co., Cons., which produced gold as a byproduct of its sand and gravel business.

### HUMBOLDT COUNTY

*Orleans district.*—Hydraulicking at the Pearch mine made it the largest gold producer in Humboldt County in 1938.

### IMPERIAL COUNTY

*Cargo Muchacho district.*—O'Brien Mines, Inc., which succeeded Socorro Mines, Inc., April 1, 1938, as operator of the American Girl mine, produced 54,155 tons of gold ore. The ore was treated in the company 160-ton flotation mill, and the resulting 1,192 tons of copper concentrate shipped for smelting contained 7,773 ounces of gold, 3,054 ounces of silver, and 73,588 pounds of copper. In addition to operating a custom cyanide mill near Andrade in 1938 Holmes & Nicholson Mining & Milling Co. operated the Cargo Muchacho group of claims in the nearby Cargo Muchacho district. The Sovereign Development Co. conducted a development campaign at the Sovereign mine throughout 1938 and produced some ore, which was treated by cyanidation. Small quantities of gold and silver were recovered from the cyanide leaching of the Tumco old tailings.

### INYO COUNTY

*Cerro Gordo district.*—The Morning Star Keeler Lease treated 2,500 tons of ore and 800 tons of old tailings from the Morning Star mine between April 5 and October 15, 1938, recovering 595 ounces of gold and 6,357 ounces of silver by cyanidation. The Santa Rosa mine shipped a small quantity of lead ore rich in silver. Keeler Gold Mines, Inc., treated a small tonnage of old tailings from the Trovine mine.

*Chidago district.*—The Cardinal Gold Mining Co., one of the ten leading lode gold producers in California during 1937, ceased operations August 29, 1938, owing to exhaustion of known ore bodies. In 1938, until that date, 36,468 tons of ore were treated by flotation and 1,397 tons of concentrates shipped to a smelter; the concentrates contained 8,580 ounces of gold, 2,485 ounces of silver, and 70,323 pounds of copper.

*Coso district.*—A number of small operators were reported working ore and old tailings in the Coso district during 1938.

*Darwin district.*—The Darwin Lead Co. shipped a small quantity of argentiferous lead ore from the Defiance mine in 1938.

*Echo Canyon district.*—The Inyo Consolidated Mines, Inc., which operated the Inyo mine during 1938, treated 1,500 tons of ore by amalgamation and recovered 309 ounces of gold.

*Mt. Argus district.*—Ore mined at the Oneida property in 1938 was treated by cyanidation after being crushed to ¼-inch mesh; 432 ounces of gold were recovered from 2,453 tons of ore.

*Sherman district.*—The Argus Mining Co., organized in February 1938, operated the Arondo mines under a lease and purchase agreement.

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*Slate Range district.*—The Gold Bottom Mines, Inc., worked the Copper Queen group of claims throughout 1938; the ore mined was treated in the company 25-ton flotation mill, and the resulting concentrate was shipped for smelting.

*South Park district.*—Burton Bros., Inc., worked the Ruth mine throughout 1938.

*Union district.*—A substantial tonnage of gold ore from the Reward mine, also known as the Brown Monster, was shipped during 1938.

*Wild Rose district.*—The Silver Ball and Skidoo mines were the leading producers in the Wild Rose district in 1938.

### KERN COUNTY

*Cove district.*—The Kern Mines, Inc., treated 36,410 tons of ore from the Big Blue mine by flotation during 1938 and shipped the concentrates—containing 4,934 ounces of gold and 4,901 ounces of silver—to a smelter. During the year 1,198 feet of development headings were driven.

*Green Mountain district.*—The Piute Mining Co. operated the Skyline mine in 1938.

*Mojave district.*—The Cactus Mines Co., which operated the Cactus Queen mine in the Middle Butte section of the Mojave district, was the leading silver producer in California during 1938 and one of the larger gold producers as well, despite the fact that this mine was only a prospect 2 or 3 years ago. The first dividend—$184,000—was paid during 1938. The gold-silver ore produced was treated by cyanidation and flotation, and the resulting concentrates were shipped for smelting. The Eureka Lease reported the production of 6,375 tons of gold ore in 1938 and its shipment to a custom cyanide plant for the recovery of 2,293 ounces of gold and 5,151 ounces of silver. The Fairview mine in the Rosamond section of the Mojave district was operated throughout 1938. The Golden Queen Mining Co., the largest producer in the Mojave district in 1938, operated on gold ore throughout the year. In addition to the company output of ore, an almost equal quantity of custom ore was treated at its 450-ton cyanide plant. During 1938, 13,003 feet of development headings were driven at the property. The Karma mine, one of the old properties of the district, yielded a small quantity of gold-silver ore. A substantial tonnage of ore was shipped from the Middle Butte property. The Lodestar Mining Co., one of the leading producers in the district, shipped gold-silver ore for treatment at the Golden Queen custom mill. Burton Bros., Inc., worked the Tropico mine throughout 1938 and in addition to treating ore from its own property conducted a large custom mill business; the company policy of accepting very small shipments of custom ore has been a major factor in the development of the Mojave and nearby mining districts. Development work by Whitmore Mines, Inc., and by lessees on the Whitmore property resulted in the production of a small quantity of ore. Lessees worked the Yellow Dog mine.

*Randsburg district.*—In 1938 the Butte Lode Mining Co. treated 2,846 tons of ore and recovered 830 ounces of gold and 239 ounces of silver by amalgamation. Small tonnages of ore and old tailings were treated at the King Solomon property. A considerable tonnage of low-grade ore from the Operator mine was handled by the Operator

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Consolidated Mines Co. The Anglo American Mining Corporation, Ltd., which operated the Yellow Aster mine, was the leading producer in the Randsburg district. Material produced from the company open pit was treated by stage crushing and screening to eliminate the larger part of the bulk as waste; the undersize was ground and amalgamated, and the tailings were sent to the company cyanide plant where they were treated along with large quantities of old tailings. In all, 189,979 tons of ore and 374,694 tons of old tailings were handled to recover 14,012 ounces of gold and 4,062 ounces of silver.

### LOS ANGELES COUNTY

The Western Graphite Co. flotation mill at Lake Hughes, which had treated custom ore for several years, suspended operation during 1938; the mill was dismantled.

*Cedar district.*—The Governor Mine Co., the largest mine in the Cedar district in 1938, treated a substantial tonnage of ore and old tailings from the Governor mine by amalgamation.

*Neenach district.*—A small quantity of ore was shipped during 1938 from the Valvue mine for treatment at custom flotation and cyanide mills.

### MADERA COUNTY

A number of small lode and placer mines were active in the Hildreth and Potter Ridge districts during 1938.

### MARIPOSA COUNTY

*Colorado district.*—Lessees operated the Schroeder group from February 16 until the end of 1938 and produced 329 tons of ore, from which 469 ounces of gold and 61 ounces of silver were recovered by amalgamation.

*Hunter Valley district.*—The Cotton Creek Mining Co. treated 2,037 tons of gold ore between May 1 and the end of 1938 and recovered 459 ounces of gold and 219 ounces of silver; the company built a 35-ton amalgamation and flotation mill during the year. The Mt. Gaines Mining Co. produced a substantial tonnage of gold ore. Cyanidation of 3,015 tons of old tailings at the Ruth Pierce mine yielded 153 ounces of gold and 126 ounces of silver; a 72-hour leaching period was used at the 15-ton cyanide leaching plant.

*Mother Lode district.*—The Bandarita Mining Co. treated 3,251 tons of ore from its property in the Mother Lode district by amalgamation and flotation during 1938 and recovered 401 ounces of gold and 322 ounces of silver. The Bondurant Mining & Milling Co. and the Carda Mining Co. (Champion mine) were active. The Boston California Mining Co. installed a 100-ton flotation mill at the Malvina mine and treated a substantial quantity of ore before the end of 1938. Operation of the Miocene No. 2 and Goldbug claims in the Coulterville section of the Lode yielded 145 tons of ore, from which 559 ounces of gold and 120 ounces of silver were extracted by amalgamation. The Pacific Mining Co., which operated the Pine Tree and Josephine mines, continued to be the leading producer of gold in Mariposa County; the company operated its 150-ton flotation mill throughout the year. The Trebor Corporation began operations with a floating washing plant fed by a 1¾-cubic-yard dragline excavator on Mariposa Creek

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September 8. The Nutting Dredging Co. also operated a dragline dredge in the district. The Placer Properties Co., Inc., operate a dragline dredge using a dragline excavator on Mariposa Creek throughout 1938.

*Whitlock district.*—The Diltz mine was the leading producer in the Whitlock district during 1938. M. T. Tresidder, a lessee on the Miner's Hope mine, treated 1,327 tons of ore and recovered 269 ounces of gold and 79 ounces of silver before his lease terminated September 22. The Our Chance Mining Co. transferred the Our Chance mine to A. E. Clark January 1; 271 tons of ore produced at the property during 1938 yielded 182 ounces of gold and 28 ounces of silver.

### MERCED COUNTY

*Snelling district.*—The connected-bucket dredges in the Snelling district produced virtually all the gold output of Merced County in 1938. The Merced Dredging Co. operated one electrically powered dredge with sixty 9½-cubic-foot buckets throughout the year. The San Joaquin Mining Co. dredged gravel 1½ miles west of Snelling; its boat was equipped with sixty-four 9½-cubic-foot buckets. The Snelling Gold Dredging Co. had two electrically powered connected-bucket dredges in operation throughout 1938; one had sixty-six 7-cubic-foot buckets and the other seventy-two 7-cubic-foot buckets. Yuba Consolidated Gold Fields, the largest producer in the district, worked two dredges of the connected-bucket type, one equipped with seventy-two 9-cubic-foot buckets and the other with seventy-one 5¾-cubic-foot buckets.

### MODOC COUNTY

*High Grade district.*—Modrell Bros. prospected the Trinity and Trinity Extension properties and produced a small quantity of gold as a result of test runs during 1938.

### MONO COUNTY

*Bodie district.*—The Roseklip Mines Co., which worked old dumps on the group of claims formerly operated by the Standard Consolidated Mining Corporation, was the largest producer of gold in Mono County in 1938; the ore was treated in a 300-ton cyanide plant. No underground development work was done on the property.

*Masonic district.*—A small quantity of gold ore was treated at the Chemung mine in 1938.

*May Lundy district.*—The Log Cabin mine was worked in 1938 by the Mutual Gold Corporation from the first of the year until April 20.

*Mount Patterson district.*—Sierra Consolidated Mines, Inc., suspended operations at the Silverado-Kentuck mines during 1938, owing to exhaustion of ore; a large quantity of silver ore was mined and treated by flotation in 1938 before the property was closed down. In 1937 this property was the leading silver producer in California.

### NAPA COUNTY

*Calistoga district.*—The Graham Loftus Oil Corporation took over the Grigsby (Palisade) mine from the Coast Range Mining Corporation during 1938. Production of gold-silver ore and its treatment by flotation were continued; concentrates were shipped for smelting.

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## NEVADA COUNTY

*Grass Valley-Nevada City district.*—Gold production from the lode mines of the Grass Valley-Nevada City district in 1938 made it again the leading metal-producing district in California and among the largest in value of metal production in the United States. Operation of the Grass Valley Bullion Mines, Inc., property continued under the company working agreement with the Idaho Maryland Mines Corporation; all the ore produced was treated at the Idaho Maryland plant. During the year a reversal of the court decision with respect to extralateral rights was a severe blow to the latter company, but early in 1939 negotiations were reported under way to settle the dispute without further litigation. The Daisy Blue Mine, Inc., worked its property from September 14 to December 3. The Empire Star Mines Co., Ltd., continued operations at its mines in Nevada and Yuba Counties. In the Grass Valley section of the Grass Valley-Nevada City district, the Empire, North Star, and Pennsylvania mines formed one of the most productive operating units in the State; in the Nevada City section of the district, the company worked the Murchie mine. In addition, the company operated the Zeibright property on Bear River near Emigrant Gap and the Pennsylvania mine at Browns Valley in Yuba County. The Newmont Mining Corporation was a very large holder of stock in these enterprises. The Golden Center mine was operated throughout the year by Cooley Butler. The Great Northern Gold Mines, Inc., worked its property 3½ miles northeast of Nevada City throughout 1938 and treated 3,000 tons of ore in its flotation mill to recover 60 tons of concentrates containing 820 ounces of gold; the company did 500 feet of development work. In 1938 the Idaho Maryland mine, operated by the Idaho Maryland Mines Corporation, attained the distinction of being the most productive single mining operation in California. According to the company annual report for the year ended December 31, 1938, 331,406 tons of ore were stoped and more than 400,000 tons of ore developed; the company paid $1,063,406.30 in dividends during 1938, bringing its total dividends to date to $3,584,429. A decision for the company in the United States Circuit Court of Appeals for the Ninth District, which held that the company was not engaged in interstate commerce and hence did not operate under the provisions of the Wagner Act, was of great importance in clarifying labor relations at gold mines in California. The Lava Cap Gold Mining Corporation operated throughout 1938 and treated 108,720 tons of ore by amalgamation and flotation to recover 30,321 ounces of gold and 301,008 ounces of silver. Not only was this company one of the leading gold producers of the State, but its silver production was one of the largest in California; 16,700 feet of development work were done during the year. The Campbell Grass Valley Mining Co. mined 5,444 tons of gold ore at the Norambagua mine 5 miles south of Grass Valley; 2,183 ounces of gold and 454 ounces of silver were produced. Late in 1938 the mill was shut down, and underground work was diverted to exploration and development. The Atlas Gold Dredging Corporation operated a washing plant and a dragline excavator with two 2½-cubic-yard buckets on Deer Creek. The Gold Star Dredging Co. began dragline dredge operations on the Douglas property on Deer Creek 2 miles west of Rough and Ready September 28; the equipment consisted of a

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1-cubic-yard all-steel washing plant and a dragline excavator with a 1-cubic-yard bucket. The Dakins Co. began dragline dredging on the Gilham and Yue claims on Wolf Creek in October and continued until the end of 1938. On May 16 the dragline dredge equipped with a 3-cubic-yard dragline excavator, moved by the Innis Dredging Co. from the Oroville district in Butte County, began operations on Deer Creek that were continued until the end of 1938. This company took over management of the Deer Creek Placer Mining Co., which had operated its dragline dredge on the property during the early months of the year.

*Washington district.*—The Bradley Mining Co., largest producer in the Washington district in 1938, operated the Spanish mine throughout the year; 22,990 tons of ore were treated by cyanidation and flotation to yield bullion, containing 976 ounces of gold and 6,477 ounces of silver, and concentrates, containing 3,566 ounces of gold, 38,687 ounces of silver, 234,440 pounds of lead, and 114,963 pounds of copper. The Shovel Placer Mining Co. treated a large quantity of gravel at a stationary washing plant to which the gravel was delivered by the use of power shovels and trucks. Omega Mine, Inc., lessees from the South Yuba Mining & Development Co., operated the Omega mine by hydraulicking.

*You Bet district.*—A dry-land dredge using a ⅞-cubic-yard dragline excavator worked the Shorty Jefferies claim during 1938, handled 5,000 cubic yards of gravel, and produced 144 ounces of gold.

### PLACER COUNTY

*Auburn district.*—Operation of the Gaylord drift mine in 1938 yielded 344 ounces of gold. In addition, numerous lode and placer mines were operated in the Auburn district.

*Butcher Ranch district.*—The Monarch Mining Co. worked the Monarch mine from January 15 to June 2, 1938; a 100-ton countercurrent decantation cyanide plant was used.

*Dutch Flat district.*—The Canyon Mines Corporation operated the Rawhide group 5 miles east of Towle throughout 1938.

*Iowa Hill district.*—The Campbell Gold Mines, Ltd., mined 1,057 cubic yards of gravel from the Campbell drift mine during 1938 and shipped 160 ounces of gold. The McGeachin Mining Co. and lessees on the Jupiter, Big Dipper, Hazelrath, Weber, Schwab, and Winchester claims in Shirttail Canyon produced 164 ounces of gold by drift mining.

*Lincoln district.*—Pantle Bros. operated a portable washing plant, to which gravel was delivered by a dragline excavator with a 1-cubic-yard bucket, at Auburn Ravine placers during 1938; 500,000 cubic yards of gravel were treated and 1,808 ounces of gold recovered. F. O. Bohnett also operated a nonfloating outfit. The Fay Placer mine 2 miles east of Lincoln was worked by a dragline dredge using a dragline excavator from March 9 until the end of the year; in addition to the gold produced, the gravels yielded a considerable quantity of zircon sand. The Lincoln Gold Dredging Co. worked its dragline dredge near Lincoln. Jasper-Stacey Co. worked its property 4 miles east of Lincoln throughout 1938 by dragline dredging, using a 2-cubic-yard electrically powered dragline excavator.

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*Ophir district.*—The Alabama California Gold Mines Co. worked the Alabama mine throughout 1938. The Auburn-Chicago Mining Co., which had operated the Chicago, Elizabeth, and Mary Len claims for several years, discontinued operations November 25. The Oro Fino Consolidated Mines worked the Oro Fino mine; the company ore was treated in a 300-ton amalgamation and flotation plant erected during the year, and the concentrates were shipped to the Idaho Maryland custom cyanide plant. The Burm-Ball Mining Co. operated the Sisley mine throughout 1938. The Three Star Mining Co. unwatered the Three Star mine in 1938 and produced a small quantity of gold ore before the end of the year. The Gold Hill Dredging Co. operated a dredge of the connected-bucket type, equipped with eighty-seven 8½-cubic-foot buckets, on the Barton Ranch and Chabot property throughout the year. The General Utility Corporation operated a dragline dredge with a 1¼-cubic yard excavator from the first of the year until March 3, on a property 3 miles southeast of Roseville. The Panob Gold Dredging Co. operated a nonfloating washing plant to which gravel was delivered by a dragline excavator with a 1¼-cubic-yard bucket from August 5 until December 22. The Antelope Gold Dredging Co. operated a dredge of the connected-bucket type, with thirty-eight 3-cubic-foot buckets, on Antelope Creek from the first of the year until November 25. The Oro Bell Dredging Co. handled 239,700 cubic yards of gravel in its connected-bucket dredge, equipped with seventy-two 4½-cubic-foot buckets, in 1938; 1,360 ounces of gold were recovered.

### PLUMAS COUNTY

*Crescent Mills district.*—The North Canyon Mines, Inc., produced 20,020 tons of gold ore in 1938 from the Droege and New York mines, which yielded 3,251 ounces of gold; the ore was treated in the company 70-ton amalgamation and flotation mill. The Indian Valley Mining Co., Inc., worked the Standart mine throughout the year and built a 125-ton amalgamation-flotation mill to replace the 10-stamp mill formerly used at the property. The Glacier drift mine yielded 365 ounces of gold from 2,881 tons of gravel as a result of intermittent operations during 1938.

*Genesee district.*—The Walker mine (operated by the Walker Mining Co., an affiliate of the Anaconda Copper Mining Co.), the outstanding mine in Plumas County for many years, dropped to second place in value of production during 1938 owing to decreased output. The property was on a curtailed basis from January 1 to May 31, on a shut-down basis from June 1 to October 31, and on an operating basis from November 1 to December 31. According to the company printed annual report for the year ended December 31, 1938:

> 75,160 wet tons of ore were broken, 66,822 dry tons of ore were milled, and 2,516 dry tons of concentrates produced in the company's 1,800-ton flotation plant. Net recoverable metal content of the 2,463 dry tons of concentrates and lime scale shipped was: Copper, 1,188,271 pounds; silver, 44,273 ounces; and gold, 2,029 ounces.

*Rich Bar district.*—The Virgilia Mining Corporation operated the Ohio Point quartz claim throughout 1938, and the value of its product was the largest in Plumas County; the ore was treated in the company

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250-ton flotation mill, and the resulting concentrates were shipped for smelting. Lord & Bishop operated a dragline dredge with a 1½-cubic-yard excavator at Grays Flat from August 1 until the end of the year and produced 741 ounces of gold.

### RIVERSIDE COUNTY

*Chuckawalla district.*—The output at the Red Cloud lode property was the largest in the Chuckawalla district in 1938.

*Dale district.*—A number of small lode operations in 1938 were reported in the Riverside County part of the Dale district, but the principal producer of the district was across the line in San Bernardino County.

*Eagle Mountain district.*—The Imperial Smelting & Refining Co. worked the Black Eagle mine intermittently during 1938 and treated 2,025 tons of ore and 4,375 tons of old tailings in its 75-ton concentration mill to produce 247 tons of lead-copper concentrates; the concentrates contained 342 ounces of gold, 4,610 ounces of silver, 242,246 pounds of lead, and 18,616 pounds of copper.

*Pinacate district.*—The Ida Leona Mine & Milling Co. worked the Ida Leona mine throughout 1938. During the year the shaft was sunk from the 100- to the 200-foot level and some new machinery was installed on the surface; 1,297 tons of gold ore were treated to yield 868 ounces of gold and 254 ounces of silver.

### SACRAMENTO COUNTY

*Cosumnes River district.*—The Cosumnes Gold Dredging Co. operated a sixty-three 12-cubic-foot connected-bucket dredge throughout 1938 and handled 3,411,337 cubic yards of gravel, which yielded 11,018 ounces of gold. Lord & Bishop operated a dragline dredge from January 1 to July 7 and recovered 2,064 ounces of gold from 247,500 cubic yards of gravel.

*Folsom district.*—The Capital Dredging Co. operated three connected-bucket dredges throughout 1938 in the Folsom district; one had sixty-two 8½-cubic-foot buckets, another eighty-eight 18-cubic-foot buckets, and a third one hundred 18-cubic-foot buckets. The General Utility Corporation operated a washing plant and a 1½-cubic-yard dragline excavator until October 3; on October 27 the General Dredging Corporation took over the operation and continued it until the end of the year. The Gold Hill Dredging Co. produced a considerable quantity of gold from the clean-up of a dredge formerly operated in the Folsom district but moved during 1938 to the Ophir district in Placer County. The Natomas Co., the largest operator in Sacramento County, was working a fleet of seven electrically operated connected-bucket dredges in the Folsom district at the end of 1938. The number and size of buckets per dredge were: No. 1 dredge, sixty-two 16-cubic-foot buckets; No. 4, sixty-seven 15-cubic-foot buckets; No. 5, one hundred and five 12-cubic-foot buckets; No. 6, one hundred and six 11-cubic-foot buckets; No. 7, ninety-eight 9-cubic-foot buckets; No. 8, one hundred and five 12-cubic-foot buckets; and No. 10, eighty-three 15-cubic-foot buckets. The Hoosier Gulch Placers operated a dragline dredge 5 miles southeast of Sloughhouse throughout the year.

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### SAN BERNARDINO COUNTY

*Buckeye district.*—The Bagdad Chase Extension Mining Syndicate conducted an extensive exploration campaign on the Butte Hill group and Roosevelt mine during 1938.

*Calico district.*—Most of the production from the Calico district in 1938 came from cyanidation of old tailings at the Old Barber, Silver King, Waterloo, and Zenda properties.

*Dale district.*—The Carlyle Mining Co. worked the Carlyle mine during 1938. The Gold Crown Mining Co., Ltd., largest producer in San Bernardino County in 1938, worked the Gold Crown group; during the year the company 50-ton cyanide plant was moved 6 miles from its former location in Riverside County into San Bernardino County.

*Halloran Springs district.*—Operation of the Lucky mine by E. Johnson and lessees in 1938 yielded 957 tons of gold ore, the larger part of which was shipped for smelting.

*Holcomb Valley district.*—The Holcomb Valley Placer Co. treated 8,000 cubic yards of gravel in 1938 to recover 103 ounces of gold between May 1 and December 20. The company operated a non-floating washing plant of the centrifugal bowl type, to which gravel was delivered by power shovel.

*Ivanpah district.*—The Colosseum Mining & Smelting Corporation worked the Colosseum mine during 1938.

*Old Woman Mountain district.*—Ore and old tailings were treated by amalgamation and concentration at the Valley View property in 1938. The Vulcan mine was active, and the ore mined was treated in an amalgamation-gravity concentration mill.

*Randsburg district.*—A large tonnage of gold-silver ore was shipped from the Kelly mine in 1938 for smelting.

### SAN FRANCISCO COUNTY

Almost 100 ounces of gold were credited to San Francisco County in 1938 in consequence of production by small-scale placer miners working the public Pacific Ocean beach sands near the San Mateo County line.

### SAN JOAQUIN COUNTY

*Linden district.*—A. G. Watkins & Sons operated a dragline dredge in the Linden district for a short period during 1938.

*Wallace district.*—The Wallace Dredging Co., which operated principally in Calaveras County in 1938, treated a small quantity of gravel when it worked for a short period across the line in San Joaquin County. Another operation on the county line, that on the K. D. Winship Estate property, recovered a substantial quantity of gold by dragline dredging in San Joaquin County.

### SAN LUIS OBISPO COUNTY

*Oro Fino district.*—F. H. Gates, Inc., recovered 215 ounces of gold between January 1 and May 26, 1938, as a byproduct of cleaning sand and gravel for highway construction. The auriferous gravel was mined on Oro Fino Canyon, a tributary of San Antonio River.

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### SHASTA COUNTY

*French Gulch district.*—Ore from the Miners Group of mines, active from September until the end of the year, was treated in a 25-ton flotation mill installed during 1938. The J. H. Scott Co. worked the Washington mine, treated 2,901 tons of ore by amalgamation and flotation, shipped 30 tons of ore for direct smelting, and recovered, in all, 1,633 ounces of gold and 422 ounces of silver. A plant, having a 50-ton rod mill, pulsating jigs, and flotation equipment, was constructed during 1938 by the company.

*Igo district.*—The area southwest of Redding, which includes the towns of Igo, Ono, Gas Point, and Cottonwood, was the scene of numerous placer operations in 1938, most of which employed dragline dredges. Cinco Mineros operated a dragline dredge using a 1½-cubic yard excavator during the last 3 months of the year. Carlson & Sandburg operated two dragline dredges during part of the year. The Pioneer Dredging Co. worked two dragline dredges on Dry Creek throughout 1938; one of the outfits was powered entirely by electricity and handled 1,356,870 cubic yards of gravel. The El Oro Dredging Co. operated a dragline excavator equipped with a 1½-cubic yard bucket. R. S. Olson operated a dragline dredge from April until the end of the year. A dragline dredge of the Pilot Dredging Co. worked intermittently on a placer property 6 miles south of Redding. Piombo Bros. & Co. operated a dragline dredge and a 1½-cubic yard bucket on Clear Creek intermittently from July 1 until the end of 1938. The Red Hill property on Olney Creek was worked with a dry-land dredge using a dragline excavator from October 3 until the end of the year. The Roaring River Gold Dredging Co. operated the only dredge of the connected-bucket type in Shasta County on its property on Roaring River; the dredge carried seventy-two 3-cubic foot buckets. During the early months of 1938 the Gold Acres Dredging Co. operated a dragline dredge, equipped with jigs, on the Thibaut Ranch.

*Iron Mountain district.*—The Mountain Copper Co., Ltd., largest mining operation in Shasta County, worked its Iron Mountain property throughout 1938. All the material mined was treated by cyanidation, one-third going to the countercurrent decantation plant and two-thirds to the sand-leaching plant.

*Old Diggings district.*—During February 1938 the Star Gulch Mining Co. turned over management of the Walker mine to the Stewart-Brown Co., which operated the property until October 10. Fourells Dredging Co. worked a section of Churn Creek 4 miles east of Redding from April 26 to May 25 by dragline dredging.

*Redding district.*—Larson Bros. constructed an 18- to 24-ton amalgamation plant on the Blue Gravel mine and treated a considerable tonnage of ore during 1938.

### SIERRA COUNTY

*Alleghany district.*—Gamble & Wilson operated the Kenton mine throughout 1938 and treated a considerable tonnage of ore by amalgamation and cyanidation in its 30-ton 10-stamp mill. Original Sixteen to One Mine, Inc., leading producer in Sierra County, worked the Sixteen to One and Tightner mines throughout the year;

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development work done totaled 2,300 feet. On April 1, O'Brien Mines, Inc., succeeded Socorro Mines, Inc., as operator of the Plumbago mine. During the year 9,753 tons of ore were treated by amalgamation and cyanidation and yielded 2,995 ounces of gold as bullion and 663 ounces by the smelting of concentrates. Development work included 557 feet of drifting, 593 feet of raising, 103 feet of sinking, and 881 feet of diamond drilling. The Kanaka Corporation abandoned its operations with a dragline dredge on Kanaka Creek 3 miles below Alleghany after working from April through July. The Lone Wolf and Gold Band claims yielded 195 ounces of gold from 7,000 cubic yards of gravel treated by hydraulicking. The Ruby mine 3½ miles southeast of Goodyears Bar was operated as a drift mine during 1938.

*Depot Hill district.*—The Depot Hill mine was worked by hydraulicking from the first of 1938 until July 14.

*Downieville district.*—The Tombstone Development Co. treated 5,000 tons of gold ore at the Bigelow mill during operations in 1938 that lasted from June until the end of the year; 815 ounces of gold and 412 ounces of silver were recovered. The Golden Bear Mines, Ltd., worked the Golden Bear drift mine.

### SISKIYOU COUNTY

*Callahan district.*—The connected-bucket dredge operated by Yuba Consolidated Gold Fields on Scott River near Callahan was the leading gold producer in the Callahan district in 1938; the dredge was equipped with seventy-two 9-cubic foot buckets.

*Greenhorn district.*—The Cal Oro Dredging Co. operated a dredge of the connected-bucket type from January 12 until the end of 1938 on the Tebbe property west of Yreka. A connected-bucket dredge with sixty-seven 6-cubic foot buckets, operated by the Yreka Gold Dredging Co., produced 10,957 ounces of gold and 1,522 ounces of silver from 1,558,069 cubic yards of gravel mined on ground 2 miles north of Yreka; this operation was the leading gold producer in Siskiyou County.

*Klamath River district.*—Klamath River has cut a deep channel many miles long through the gold-bearing mountains of Siskiyou County; many mines, most of them placers, are situated along its course. The majority of these operations are conducted on a very small scale and employ only hand methods. The St. Lawrence Mining Co., however, treated 90,000 cubic yards of gravel from the Reeves property in 1938 and recovered 812 ounces of gold by use of a stationary washing plant, to which gravel was delivered by carry-alls drawn by tractors. Drift-mining operations were reported at the Hoosier Hill placer on Klamath River. The Kookaburra Mines, Inc., operated a nonfloating washing plant to which gravel was delivered by high-line cableway using a ¾-cubic yard bucket. William von der Hellen Mines treated 32,000 cubic yards of gravel from McConnell Bar and recovered 517 ounces of gold between June 10 and August 21; this company used a stationary washing plant to which gravel was delivered by trucks loaded by a 1¼-cubic yard power shovel. Harms Bros. and Larsen Bros. began operations on Horse Creek on the Scandia mine December 1, 1938, and continued until the end of the year; a dragline dredge was used.

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*Liberty district.*—The Gold Ball Mining Co. operated the Gold Ball mine during 1938. The King Solomon Mines Co., leading lode-mine operator in Siskiyou County, worked the King Solomon mine as an open-cut. George Tulare produced 230 ounces of gold by hydraulicking 8,000 cubic yards of gravel at the Joubert mine 2 miles from Sawyers Bar. The S. T. S. mine on Eddy's Gulch was the largest hydraulic operation in the Liberty district.

*Salmon River district.*—Lessees produced 108 ounces of gold from 105 tons of ore mined in 1938 at the Ida May and Francis Bell claims between June 8 and the end of the year. Hydraulic and small-scale hand methods contributed a substantial output of placer gold in the Salmon River district.

*Scott River district.*—The Frederica lode claim was active throughout 1938. Hydraulicking was carried on at the Roxbury property.

### STANISLAUS COUNTY

*Knights Ferry district.*—Carlson & Sandburg operated two dragline dredges in the vicinity of Wildcat Creek during 1938. On the Robuck property a washing plant, to which gravel was delivered by a dragline excavator, handled 10,000 yards of gravel during intermittent operations from October until the end of the year; 122 ounces of gold were recovered.

*La Grange district.*—The La Grange Gold Dredging Co., which operated a connected-bucket dredge throughout 1938, was the leading gold producer in Stanislaus County. The Tuolumne Gold Dredging Corporation began operations June 15 with a dredge of the connected-bucket type with one hundred and one 12-cubic foot buckets and continued until the end of the year.

### TEHAMA COUNTY

*Red Bluff district.*—The Midland Co. began operations with a dragline dredge on Sacramento River February 20, 1938, and continued to the end of the year.

### TRINITY COUNTY

*Big Bar district.*—A stationary washing plant to which gravel was delivered by a ¾-cubic yard dragline excavator was operated on the Pattison Ranch from January 15 to August 29, 1938.

*Hayfork district.*—The Hayfork Gold Dredging Co. operated a 1¼-cubic yard dragline excavator and floating washing plant near Hayfork during 1938.

*Helena district.*—In 1938 Al Hansen & Co. produced at the Enterprise mine 397 tons of ore, which was treated by amalgamation and flotation to recover 262 ounces of gold and 78 ounces of silver.

*Junction City district.*—Lessees on the Bergin mine hydraulicked 75,000 cubic yards of gravel in 1938 to recover 230 ounces of gold before their leases expired October 1. The property of Canyon Placers, Inc., was worked as a hydraulic mine from January 1 to June 10. The Junction City Mining Co. operated a connected-bucket dredge on Trinity River 1 mile above Junction City throughout the year. Lessees on the Red Hill mine hydraulicked a large quantity of gravel between the first of the year and July 1. The Golden Gravels

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Mining Co. worked the Sourdough property with a 2-cubic yard dragline excavator and floating washing plant.

*Lewiston district.*—The Brown Bear Mines Corporation worked the Brown Bear mine during 1938. The dragline dredge operation on the Lowden Ranch was taken over by Interstate Mines, Inc., and was active from August until the end of the year; a 3-cubic yard excavator and 2½-cubic yard bucket were employed. On Trinity River near Lewiston the Lewiston Gold Dredging Co. operated a connected-bucket dredge with forty-six 8- and 9-cubic foot buckets throughout the year. The Trinity Dredge Co., after operating its connected-bucket dredge equipped with forty-two 11-cubic foot buckets from the first of the year until the end of October, leased it to T. D. and C. R. Harris, who continued the operation until the end of the year.

*Salyer district.*—Hydraulicking was carried on by the Swanson Mining Corporation on Trinity River and its South Fork from June 1 to 15, 1938.

*Weaverville district.*—Carlson & Sandburg continued their dragline dredge operation on Indian Creek near Douglas City during 1938. The General Utility Corporation operated a dragline dredge from November 1 until the end of the year; the equipment included a dragline excavator with one 1¼-cubic yard bucket. The Oro Trinity Dredging Co. worked a dragline dredge equipped with a 1½-cubic yard dragline. The Pioneer Dredging Co. began dragline operations in the Weaverville district in October and continued until the end of the year. The Viking Dredging Co. continued dragline dredging throughout 1938 on its property at the junction of Redding Creek and Trinity River; a floating washing plant and a dragline with a 2-cubic yard bucket were employed. The Weaver Dredging Co., the first dragline dredge operation in Trinity County, continued production throughout 1938; the company employed two plants. The Pacific Gold Dredging Co., operated a dragline dredge on West Weaver Creek from June 5 until August 21; the equipment consisted of a floating washing plant and a 1-cubic yard dragline bucket.

### TUOLUMNE COUNTY

*Columbia district.*—The Densmore Gold Mines, Inc., treated 1,570 tons of gold ore in its flotation mill in 1938 and shipped the concentrates for smelting; 2,001 ounces of gold and 975 ounces of silver were recovered. The Shoestring Mining Co. worked the Experimental group northeast of Sonora intermittently; 829 tons of ore yielded 121 ounces of gold by amalgamation and 8 ounces of gold by cyanidation of concentrates. The treatment of 1,370 tons of dump material at the National lode claim yielded 97 ounces of gold between September 16 and December 2. Operations at the Sugarman mine yielded 200 tons of ore, from which 228 ounces of gold were recovered during the period of operation from the first of the year to August 15.

*East Belt district.*—The Columbus Gold Mining Co. mined a large quantity of ore before ceasing operations in 1938. Metallic Mines produced 2,000 tons of gold ore during intermittent operations at the Longfellow mine. Lessees at the Mohrman Mine produced 475 tons of ore, from which 168 ounces of gold were recovered by amalgamation.

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*Mother Lode district.*—Hemming Bros. treated 456 tons of ore by amalgamation and concentration and recovered 126 ounces of gold at the Alameda mine during 1938. Miller & Clemson worked the Eagle Shawmut mine from the first of the year until December 16. During the early months of the year surface ores were treated by cyanidation, but this work was abandoned because of poor recovery; the rest of the year, ore was treated in the company concentrating mill. In all 3,719 ounces of gold and 1,342 ounces of silver were recovered, principally by smelting of concentrates. Gold Diggers Syndicate worked the Heslep, App, Dutch, and Sweeney mines throughout 1938. The ore was treated in the company 50-ton flotation plant; 608 tons of concentrates were produced from 16,445 tons of ore and yielded 2,327 ounces of gold and 1,495 ounces of silver. E. A. Kent operated a dragline dredge on Tuolumne River, Woods Creek, and Curtis Creek. Moccasin Mine operated a dragline dredge on Moccasin Creek throughout 1938. Rim Cam Gold Dredging Co. operated a dredge, using a dragline with a 1-cubic yard bucket, on Woods Creek from April 17 to August 15.

### YUBA COUNTY

*Bear River district.*—Camp Far West Mining Co. suspended all operations at its property 5 miles east of Wheatland August 4, 1938; the company produced 250 ounces of gold from 16,000 yards of gravel, using a nonfloating washing plant to which gravel was delivered by a dragline excavator with ¾-cubic yard bucket.

*Browns Valley district.*—The Pennsylvania mine, operated by the Empire Star Mines Co., Ltd., was the outstanding lode producer in Yuba County in 1938.

*Challenge district.*—Operations at the Horseshoe mine in 1938 produced 1,830 tons of gold ore, which yielded 328 ounces of gold by amalgamation and concentration.

*Smartville district.*—A lessee on the Blue Point drift mine treated 4,688 tons of gravel to produce 267 ounces of gold during 1938. The Williams Bar Dredging Co. handled 2,872,621 cubic yards of gravel in its connected-bucket dredge during the full year's operations and recovered 8,582 ounces of gold and 629 ounces of silver. On Yuba River near Smartville was one of the largest camps of "snipers" in California during 1938; an average of 100 or more men camped along 2 miles of the river throughout the year.

*Yuba River district.*—Yuba Consolidated Gold Fields operated a fleet of five large electrically operated connected-bucket dredges in the Yuba River district throughout 1938, equipped as to number and capacity of buckets as follows: Eighty-seven 18-cubic foot, one hundred 18-cubic foot, one hundred and twenty-six 18-cubic foot, one hundred 18-cubic foot, and eighty-seven 18-cubic foot buckets. This company's operation was by far the largest in Yuba County and one of the largest single gold-producing operations in California.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

## SUMMARY OUTLINE


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Colorado mines yielded gold, silver, copper, lead, and zinc valued, in terms of recovered metals, at $22,073,663 in 1938 compared with $22,107,207 in 1937. Gold, with no change in price during the 2 years and with only a very small difference in quantity produced each year (less than one-half of 1 percent decrease in 1938 from 1937), represented 58 percent of the total metal value in each year. The quantity of silver and copper produced increased 27 and 30 percent, respectively, in 1938 over 1937, but because of the lower average prices in 1938 the total value increased only 6 and 5 percent, respectively. Silver contributed 23 percent of the total metal value in 1938 and copper 13 percent. Lead production decreased 3 percent, and zinc increased 7 percent in quantity from 1937; lead, however, decreased 25 percent and zinc 21 percent in total value. Most of the principal producers in 1937 of gold, gold-silver, and silver ores and of base-metal ores mined because of their gold and silver content continued operations throughout 1938; and the number of small gold-mining enterprises increased. The output of zinc-lead-copper-silver-gold ore, however, was made almost entirely in the first half of the year, as the State's largest producer of zinc and lead in 1937 was shut down after June 1938, and only a small quantity of zinc, zinc-lead, and complex zincky ores was shipped from other mines in the State in the latter half of 1938.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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Annual figures for the 5 years ended with 1938, given in the table that follows, show a general upward trend in production over the period and large total gains for all five metals. Colorado has produced more silver in the past than any other State in the United States and ranks second in total recorded output of gold.

*Mine production of gold, silver, copper, lead, and zinc in Colorado, 1934–38, and total, 1858–1938, in terms of recovered metals*

| Year | Mines producing | | Ore sold or treated (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 929 | 967 | 1,309,187 | 324,923.32 | $11,356,070 | 3,475,661 | $2,246,892 |
| 1935 | 870 | 842 | 1,770,984 | 349,280.80 | 12,224,828 | 4,696,064 | 3,375,296 |
| 1936 | 714 | 601 | 2,151,849 | 366,607.00 | 12,831,245 | 5,902,776 | 4,571,700 |
| 1937 | 655 | 490 | 2,068,619 | 368,905.00 | 12,911,675 | 6,260,693 | 4,842,646 |
| 1938 | 669 | 592 | 1,996,095 | 367,468.00 | 12,861,380 | 7,932,095 | 5,127,819 |
| 1858–1938 | ------ | -------- | (1) | 37,182,538.00 | 795,265,794 | 692,441,670 | 540,616,152 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 11,294,000 | $903,520 | 8,435,000 | $312,095 | 1,544,000 | $66,392 | $14,884,969 |
| 1935 | 14,654,000 | 1,216,282 | 11,345,000 | 453,800 | 2,403,000 | 105,732 | 17,375,938 |
| 1936 | 17,730,000 | 1,631,160 | 14,534,000 | 668,564 | 2,344,000 | 117,200 | 19,819,869 |
| 1937 | 21,868,000 | 2,646,028 | 19,572,000 | 1,154,748 | 8,494,000 | 552,110 | 22,107,207 |
| 1938 | 28,342,000 | 2,777,516 | 18,910,000 | 869,860 | 9,106,000 | 437,088 | 22,073,663 |
| 1858–1938 | [2] 212,179 | 57,411,599 | [2] 2,344,619 | 221,341,809 | [2] 1,128,402 | 158,400,516 | 1,773,035,870 |

[1] Figures not available.
[2] Short tons.

*Gold and silver produced at placer mines in Colorado, 1934–38, in fine ounces, in terms of recovered metals*

| Year | Sluicing and hydraulic | | Drift mining | | Dredges | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Dry-land [1] | | Dragline floating | | Floating bucket | | | |
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| 1934 | [2] 4,086.39 | [2] 855 | (2) | (2) | 3,594.34 | 533 | ------- | ------ | 7,292.26 | 1,828 | 14,972.99 | 3,216 |
| 1935 | [2] 7,058.74 | [2] 1,523 | (2) | (2) | 7,998.55 | 1,329 | ------- | ------ | 4,305.71 | 1,116 | 19,363.00 | 3,968 |
| 1936 | 2,307.74 | 573 | 1,990.14 | 403 | 7,754.79 | 1,365 | ------- | ------ | 1,528.33 | 364 | 13,581.00 | 2,705 |
| 1937 | 1,948.21 | 401 | 2,020.13 | 411 | 6,212.24 | 1,033 | 2,780.35 | 286 | 1,910.07 | 434 | 14,871.00 | 2,565 |
| 1938 | 2,285.28 | 433 | 1,361.40 | 279 | 10,201.31 | 2,020 | 3,166.09 | 279 | 1,026.92 | 239 | 18,041.00 | 3,250 |

[1] Dragline and power-shovel excavators with sluices or special amalgamators.
[2] Figures for sluicing and hydraulic include those for drift mining.

*Gold.*—The principal gold-producing districts of Colorado in 1938, in order, were the Cripple Creek district, Teller County; Mosquito, Park County; Animas, San Juan County; Summitville, Rio Grande County; Empire, Clear Creek County; Redcliff, Eagle County; Upper San Miguel, San Miguel County; Gold Hill, Boulder County; Sneffels, Ouray County; and Leadville, Lake County. The three largest gold-producing properties in the State during the year were the United Gold Mines, Cresson, and Golden Cycle-Ajax, all in the Cripple Creek

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district; the London mine in the Mosquito district ranked fourth, Summitville Consolidated Mines group at Summitville fifth, Shenandoah-Dives-Mayflower group at Silverton sixth, Minnesota Mines group at Empire seventh, Eagle mine at Gilman eighth, Smuggler Union group at Telluride ninth, and Camp Bird in Ouray tenth. Substantial gains in gold production were made in San Miguel, Eagle, Rio Grande, Ouray, Boulder, and San Juan Counties. The largest decreases from 1937 occurred in Park, Lake, Summit, La Plata, and Gilpin Counties. Dry and siliceous ores yielded 87 percent of the total gold; copper ore 5 percent; lead, lead-copper, zinc, and zinc-lead ores 3 percent; and placers 5 percent.

*Silver.*—Eagle County produced 67 percent of the State total output of silver in 1938 compared with 65 percent in 1937 and 63 percent in 1936. San Juan County continued in second place, and San Miguel County rose from fourth in 1937 to third in 1938. Mineral County ranked fourth, followed in order by Ouray, Pitkin, Clear

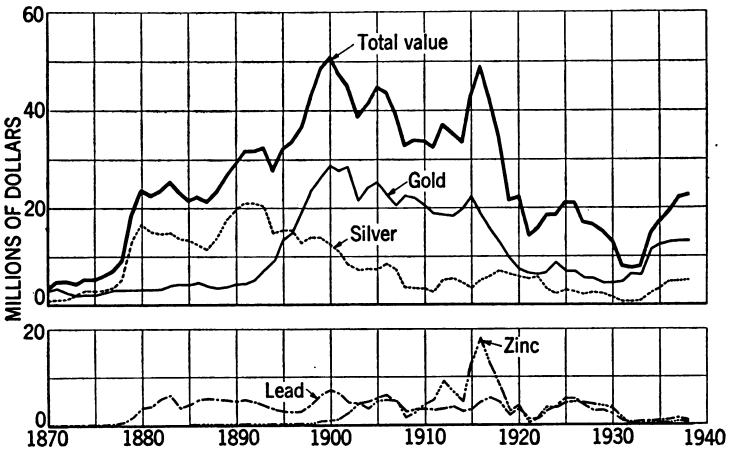


FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1938. The value of copper has been less than $2,000,000 annually, except in a few years.

Creek, Saguache, and Lake. The chief silver-producing properties in 1938 were: Eagle mine group, Eagle County; Shenandoah-Dives-Mayflower and Sunnyside groups, San Juan County; Pittsburg-Last Chance-Del Monte group, Mineral County; and Smuggler Union and Butterfly groups, San Miguel County. Copper ore yielded 69 percent of the State total output of silver; dry and siliceous ore 26 percent; zinc-lead ore 3 percent; and other types of ore, together with a very small quantity from placer mines, 2 percent.

*Copper.*—In 1938 copper production in Colorado surpassed the previous record annual output of 1937 by 6,474,000 pounds and set a new record—28,342,000 pounds. Eagle County produced 85 percent of the State total in 1938 and San Juan County 7 percent; most of the remainder came from Saguache, Ouray, and Clear Creek Counties. The principal copper-producing companies were the New Jersey Zinc Co. Empire Zinc Division at Gilman, Shenandoah-Dives Mining Co. at Silverton, Rawley Mines at Bonanza, and Sunnyside Mining & Milling Co. at Eureka. Copper ore yielded 87 percent of the total

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copper, dry and siliceous ores 10 percent, and other types of ore 3 percent.

*Lead.*—The output of lead in Colorado in 1938 decreased 3 percent in quantity and 25 percent in value from 1937. San Juan County produced nearly half of the State total in 1938; Lake, San Miguel, and Eagle Counties each produced more than 1,000,000 pounds. The Sunnyside mine in San Juan County was the largest individual producer of lead in the State during the year. Dry and siliceous ores yielded nearly 39 percent of the total lead, zinc-lead ores 33 percent, lead and lead-copper ores 18 percent, and copper ore 10 percent.

*Zinc.*—In the 5-year period from 1932 to 1936, inclusive, Colorado produced only 9,078,000 pounds of recoverable zinc, most of which was contained in zinc-lead sulfide ore shipped from Lake County to the pigment plant at Coffeyville, Kans.; in byproduct zinc concentrates derived from dry and siliceous silver ore from Pitkin County; and in zinc-lead-gold-silver-copper ore shipped from widely scattered districts to custom concentrators in Utah. In September 1937 the Sunnyside zinc-lead mine in San Juan County was reopened and was operated through June 1938, producing most of the State output of zinc in 1937 and 1938. No zinc-lead ore was shipped to Coffeyville from Lake County in 1938, but a few operators continued to ship zinc-lead-gold-silver-copper ores to Utah custom mills from Lake and other counties and the Midnight Mining Co. in Pitkin County continued to make byproduct zinc concentrates. In October 1938 the Shenandoah-Dives Mining Co., a large producer of dry and siliceous gold-silver ore containing some lead, copper, and zinc and a buyer of custom complex lead and zinc-lead ores for treatment in its mill, changed its treatment process from bulk lead flotation (with some zinc concentrates) to selective flotation and thereafter made flotation zinc, lead, and copper concentrates and table iron concentrates.

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## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value |
| Adams | | 11 | 91.80 | $3,213 | 14 | $9 |
| Arapahoe | | 8 | 20.00 | 700 | 1 | 1 |
| Boulder | 154 | 11 | 23,049.40 | 806,729 | 38,763 | 25,059 |
| Chaffee | 11 | 16 | 472.40 | 16,534 | 4,834 | 3,125 |
| Clear Creek | 97 | 47 | 33,328.40 | 1,166,494 | 130,134 | 84,127 |
| Conejos | 1 | | 12.60 | 441 | 916 | 592 |
| Costilla | | 2 | 13.80 | 483 | 3 | 2 |
| Custer | 3 | | 145.00 | 5,075 | 2,772 | 1,792 |
| Denver | | 9 | 7.40 | 259 | | |
| Dolores | 4 | 4 | 58.80 | 2,058 | 4,927 | 3,185 |
| Douglas | | 15 | 41.20 | 1,442 | | |
| Eagle | 10 | 7 | 17,445.20 | 610,582 | 5,307,342 | 3,431,009 |
| Elbert | | 4 | 17.40 | 609 | | |
| Fremont | 2 | 1 | 10.20 | 357 | 35 | 23 |
| Garfield | 1 | | 157.80 | 5,523 | 68 | 44 |
| Gilpin | 65 | 152 | 14,165.40 | 495,789 | 34,896 | 22,559 |
| Grand | | 2 | 2.00 | 70 | | |
| Gunnison | 12 | 4 | 828.80 | 29,008 | 4,930 | 3,187 |
| Hinsdale | 4 | | 27.40 | 959 | 5,496 | 3,553 |
| Jackson | | 1 | 1.20 | 42 | | |
| Jefferson | | 35 | 71.80 | 2,513 | 14 | 9 |
| Lake | 65 | 22 | 11,993.00 | 419,755 | 105,661 | 68,306 |
| La Plata | 6 | 2 | 229.60 | 8,036 | 1,935 | 1,251 |
| Larimer | 1 | | 22.20 | 777 | 34 | 22 |
| Mineral | 7 | | 187.20 | 6,552 | 457,595 | 295,819 |
| Moffat | | 11 | 640.60 | 22,421 | 31 | 20 |
| Montezuma | 3 | 1 | 1,891.60 | 66,206 | 3,595 | 2,324 |
| Montrose | 2 | 15 | 67.60 | 2,366 | 568 | 367 |
| Ouray | 13 | 3 | 12,760.60 | 446,621 | 213,382 | 137,944 |
| Park | 18 | 117 | 38,688.20 | 1,354,087 | 56,891 | 36,778 |
| Pitkin | 5 | | .60 | 21 | 190,578 | 123,202 |
| Rio Grande | 2 | | 19,768.60 | 691,901 | 50,855 | 32,876 |
| Routt | | 4 | 41.00 | 1,435 | 19 | 12 |
| Saguache | 11 | | 258.00 | 9,030 | 124,825 | 80,695 |
| San Juan | 21 | 2 | 26,515.60 | 928,046 | 647,712 | 418,723 |
| San Miguel | 24 | 13 | 17,134.40 | 599,704 | 471,689 | 304,930 |
| Summit | 21 | 62 | 2,085.80 | 73,003 | 56,085 | 36,257 |
| Teller | 106 | 11 | 145,215.40 | 5,082,539 | 15,495 | 10,017 |
| | 669 | 592 | 367,468.00 | 12,861,380 | 7,932,095 | 5,127,819 |
| Total, 1937 | 655 | 490 | 368,905.00 | 12,911,675 | 6,260,693 | 4,842,646 |

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*Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, by counties, in terms of recovered metals*—Continued

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Adams | | | | | | | $3,222 |
| Arapahoe | | | | | | | 701 |
| Boulder | 85,000 | $8,330 | 164,000 | $7,544 | | | 847,662 |
| Chaffee | 4,400 | 431 | 212,000 | 9,752 | 48,000 | $2,304 | 32,146 |
| Clear Creek | 423,000 | 41,454 | 685,000 | 31,510 | 30,000 | 1,440 | 1,325,025 |
| Conejos | | | | | | | 1,033 |
| Costilla | | | | | | | 485 |
| Custer | | | 24,000 | 1,104 | | | 7,971 |
| Denver | | | | | | | 259 |
| Dolores | 3,400 | 333 | 57,000 | 2,622 | 60,000 | 2,880 | 11,078 |
| Douglas | | | | | | | 1,442 |
| Eagle | 24,026,000 | 2,354,548 | 1,865,000 | 85,790 | | | 6,481,929 |
| Elbert | | | | | | | 609 |
| Fremont | 9,400 | 921 | | | | | 1,301 |
| Garfield | 100 | 10 | | | | | 5,577 |
| Gilpin | 23,000 | 2,254 | 101,000 | 4,646 | | | 525,248 |
| Grand | | | | | | | 70 |
| Gunnison | 100 | 10 | 19,000 | 874 | 29,000 | 1,392 | 34,471 |
| Hinsdale | 6,500 | 637 | 141,000 | 6,486 | 6,000 | 288 | 11,923 |
| Jackson | | | | | | | 42 |
| Jefferson | | | | | | | 2,522 |
| Lake | 57,000 | 5,586 | 2,449,000 | 112,654 | 193,000 | 9,264 | 615,565 |
| La Plata | 100 | 10 | 1,900 | 87 | | | 9,384 |
| Larimer | | | | | | | 799 |
| Mineral | | | 241,000 | 11,086 | | | 313,457 |
| Moffat | | | | | | | 22,441 |
| Montezuma | 3,000 | 294 | 100 | 5 | | | 68,829 |
| Montrose | 13,600 | 1,333 | | | | | 4,066 |
| Ouray | 723,500 | 70,903 | 852,000 | 39,192 | | | 694,660 |
| Park | 55,000 | 5,390 | 838,000 | 38,548 | | | 1,434,803 |
| Pitkin | 500 | 49 | 440,000 | 20,240 | 160,000 | 7,680 | 151,192 |
| Rio Grande | 10,000 | 980 | | | | | 725,757 |
| Routt | | | | | | | 1,447 |
| Saguache | 736,000 | 72,128 | 227,000 | 10,442 | | | 172,295 |
| San Juan | 2,021,000 | 198,058 | 8,011,000 | 368,506 | 8,549,000 | 410,352 | 2,323,685 |
| San Miguel | 138,000 | 13,524 | 2,240,000 | 103,040 | | | 1,021,198 |
| Summit | 3,400 | 333 | 342,000 | 15,732 | 31,000 | 1,488 | 126,813 |
| Teller | | | | | | | 5,092,556 |
| | 28,342,000 | 2,777,516 | 18,910,000 | 869,860 | 9,106,000 | 437,088 | 22,073,663 |
| Total, 1937 | 21,868,000 | 2,646,028 | 19,572,000 | 1,154,748 | 8,494,000 | 552,110 | 22,107,207 |

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*Gold and silver produced at lode mines in Colorado in 1938, by counties, in terms of recovered metals*

| County | Ore sold or treated | Gold | Silver |
|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* |
| Boulder | 78,911 | 22,617.40 | 38,729 |
| Chaffee | 810 | 219.20 | 4,797 |
| Clear Creek | 223,611 | 33,233.20 | 130,120 |
| Conejos | 500 | 12.60 | 916 |
| Custer | 1,549 | 145.00 | 2,772 |
| Dolores | 393 | 52.80 | 4,927 |
| Eagle | 327,741 | 17,427.00 | 5,307,342 |
| Fremont | 64 | 4.20 | 34 |
| Garfield | 103 | 157.80 | 68 |
| Gilpin | 50,582 | 5,829.00 | 33,510 |
| Gunnison | 6,803 | 823.00 | 4,930 |
| Hinsdale | 1,283 | 27.40 | 5,496 |
| Lake | 47,766 | 10,229.40 | 105,234 |
| La Plata | 2,996 | 222.20 | 1,935 |
| Larimer | 11 | 22.20 | 34 |
| Mineral | 35,656 | 187.20 | 457,595 |
| Montezuma | 682 | 1,890.80 | 3,595 |
| Montrose | 119 | 1.80 | 549 |
| Ouray | 54,419 | 12,751.40 | 213,379 |
| Park | 130,105 | 34,109.00 | 56,034 |
| Pitkin | 27,935 | .60 | 190,578 |
| Rio Grande | 37,207 | 19,768.60 | 50,855 |
| Saguache | 8,357 | 258.00 | 124,825 |
| San Juan | 331,725 | 26,511.00 | 647,712 |
| San Miguel | 124,919 | 17,070.60 | 471,664 |
| Summit | 3,491 | 670.00 | 55,723 |
| Teller | 498,357 | 145,185.60 | 15,492 |
| Total, 1937 | 1,996,095 | 349,427.00 | 7,928,845 |
| | 2,068,619 | 354,034.00 | 6,258,128 |

*Gold and silver produced at placer mines in Colorado in 1938, by counties, in fine ounces, in terms of recovered metals*

| County | Sluicing and hydraulic | | Drift mining | | Dredges | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Dry-land [1] | | Dragline floating | | Floating bucket | | | |
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| Adams | 91.80 | 14 | | | | | | | | | 91.80 | 14 |
| Arapahoe | 20.00 | 1 | | | | | | | | | 20.00 | 1 |
| Boulder | 28.39 | 1 | | | 403.61 | 33 | | | | | 432.00 | 34 |
| Chaffee | 69.65 | 10 | | | 183.55 | 27 | | | | | 253.20 | 37 |
| Clear Creek | 95.20 | 14 | | | | | | | | | 95.20 | 14 |
| Costilla | 13.80 | 3 | | | | | | | | | 13.80 | 3 |
| Denver | 7.40 | | | | | | | | | | 7.40 | |
| Dolores | 6.00 | | | | | | | | | | 6.00 | |
| Douglas | 40.31 | | | | .89 | | | | | | 41.20 | |
| Eagle | 18.20 | | | | | | | | | | 18.20 | |
| Elbert | 17.40 | | | | | | | | | | 17.40 | |
| Fremont | 6.00 | 1 | | | | | | | | | 6.00 | 1 |
| Gilpin | 546.99 | 101 | | | 4,623.32 | 1,006 | 3,166.09 | 279 | | | 8,336.40 | 1,386 |
| Grand | 2.00 | | | | | | | | | | 2.00 | |
| Gunnison | 5.80 | | | | | | | | | | 5.80 | |
| Jackson | 1.20 | | | | | | | | | | 1.20 | |
| Jefferson | 71.80 | 14 | | | | | | | | | 71.80 | 14 |
| Lake | 34.00 | 6 | | | 1,729.60 | 421 | | | | | 1,763.60 | 427 |
| La Plata | 1.70 | | | | 5.70 | | | | | | 7.40 | |
| Moffat | 33.61 | 1 | | | 606.99 | 30 | | | | | 640.60 | 31 |
| Montezuma | .80 | | | | | | | | | | .80 | |
| Montrose | 65.80 | 19 | | | | | | | | | 65.80 | 19 |
| Ouray | 9.20 | 3 | | | | | | | | | 9.20 | 3 |
| Park | 664.06 | 129 | 1,361.40 | 279 | 2,183.58 | 367 | | | 370.16 | 82 | 4,579.20 | 857 |
| Routt | 1.77 | | | | 39.23 | 19 | | | | | 41.00 | 19 |
| San Juan | 4.60 | | | | | | | | | | 4.60 | |
| San Miguel | 63.80 | 25 | | | | | | | | | 63.80 | 25 |
| Summit | 334.20 | 88 | | | 424.84 | 117 | | | 656.76 | 157 | 1,415.80 | 362 |
| Teller | 29.80 | 3 | | | | | | | | | 29.80 | 3 |
| | 2,285.28 | 433 | 1,361.40 | 279 | 10,201.31 | 2,020 | 3,166.09 | 279 | 1,026.92 | 239 | 18,041.00 | 3,250 |
| Total, 1937 | 1,948.21 | 401 | 2,020.13 | 411 | 6,212.24 | 1,033 | 2,780.35 | 286 | 1,910.07 | 434 | 14,871.00 | 2,565 |

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

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## MINING INDUSTRY

A study of the output of individual mines in Colorado in 1938 shows that 35 operations employing 25 to 460 men (totaling 3,384) produced 97 percent of the State output of copper, 93 percent of the zinc, 85 percent of the silver, 74 percent of the gold, and 73 percent of the lead. Compared with 1937 there was a decrease in 1938 of 14 in the number of lode mines employing 25 or more men. Six mines in this group that were active in 1937 suspended production before the end of that year; but one new operator appeared in the group in 1938, and nine continued operations but employed fewer men in 1938 than in 1937. The number employing less than 25 men in 1938, comprising the 9 mentioned above and others, including many small gold mines, prospects, and dumps worked by individuals and groups with a minimum of expense for equipment, increased from 606 in 1937 to 634 in 1938. Data on the total number of men working at the 634 small operations are not available, but the number is considerably larger relative to the quantity of metal produced than at the 35 large operations. Dry and siliceous gold, gold-silver, and silver ores comprised 76 percent of the State total output of ore in 1938; copper ore 17 percent; zinc-lead ore 6 percent; and other types of ore 1 percent.

Approximately 1,841,965 cubic yards of gravel were handled in 1938 by 2 floating connected-bucket dredges and 25 dry-land and dragline floating dredges; specific data on yardage handled at small-scale placer operations are not obtainable because of lack of knowledge by the operators of the quantity of gravel sluiced. Although there was some expansion in placer mining in 1938 resulting in the expenditure of money for equipment, the output of gold from placers amounted to only 5 percent of the State total, and none of the individual operators employed more than 24 men.

### ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore sold or treated in Colorado in 1938, with content in terms of recovered metals*

| Source | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 1,071,562 | 282,183.36 | 360,262 | 1,005,965 | 2,226,457 | ---------- |
| Dry and siliceous gold-silver ore | 379,456 | 39,117.00 | 945,449 | 1,837,495 | 4,191,895 | 215,000 |
| Dry and siliceous silver ore | 77,640 | 328.04 | 767,801 | 25,920 | 883,295 | 160,000 |
| | 1,528,658 | 321,628.40 | 2,073,512 | 2,869,380 | 7,301,647 | 375,000 |
| Copper ore | 333,103 | 17,131.25 | 5,421,143 | 24,750,110 | 1,960,667 | ---------- |
| Lead ore | 19,646 | 6,604.45 | 169,223 | 47,430 | 3,356,881 | 28,000 |
| Lead-copper ore | 37 | 9.36 | 366 | 2,500 | 6,200 | ---------- |
| Zinc ore | 145 | 11.87 | 83 | ---------- | 2,300 | 42,000 |
| Zinc-lead ore | 114,506 | 4,041.67 | 264,518 | 672,580 | 6,282,305 | 8,661,000 |
| | 467,437 | 27,798.60 | 5,855,333 | 25,472,620 | 11,608,353 | 8,731,000 |
| Total, lode mines | 1,996,095 | 349,427.00 | 7,928,845 | 28,342,000 | 18,910,000 | 9,106,000 |
| Total, placers | ---------- | 18,041.00 | 3,250 | ---------- | ---------- | ---------- |
| | 1,996,095 | 367,468.00 | 7,932,095 | 28,342,000 | 18,910,000 | 9,106,000 |
| Total, 1937 | 2,068,619 | 368,905.00 | 6,260,693 | 21,868,000 | 19,572,000 | 8,494,000 |

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## METALLURGIC INDUSTRY

The construction and maintenance of suitable ore-reduction mills and treatment plants have contributed materially to prolongation of the productive life of some of the old gold- and silver-producing districts of Colorado during the past few years. Many of the mines are situated in regions not reached by railroads or main highways, and it is necessary to make concentrated products containing the recoverable commercial metals in forms that can be transported economically to distant points and sold in the markets that offer the highest net return to the operator. Gold and silver recovered as amalgam and retorted and bullion, nuggets, and grains containing 20 percent or more gold or gold and silver combined can be sold direct to the United States mints and assay offices where the total melting, refining, and handling charges average only about 17 cents per fine ounce of gold. For this reason a number of flotation mills use mat-lined launders, jigs, and corduroy blanket or burlap tables in the ball-mill classifier circuit or following the classifier to remove concentrates containing free gold and heavy sulfides for treatment in amalgam barrels or iron arrastre; however, some of the concentrates made in this manner are shipped to smelters. The percentage of the State total lode gold recovered by amalgamation rose from 17 percent in 1934 to 20 percent in 1938; that recovered by cyanidation from 37 to 41 percent; and that recovered in concentrates and from crude ore smelted decreased from 46 to 39 percent.

*Mine production of metals in Colorado in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore and concentrates amalgamated [1] | 770,788 | 69,157.00 | 24,114 | | | |
| Ore, concentrates, sands, and slimes cyanided [2] | [3] 591,197 | 142,858.81 | 89,849 | | | |
| Concentrates smelted | 77,893 | 102,703.64 | 2,017,721 | 3,471,090 | 13,759,162 | 9,064,000 |
| Ore smelted | 377,320 | 34,707.55 | 5,797,161 | 24,870,910 | 5,150,838 | 42,000 |
| Placer [1] | | 18,041.00 | 3,250 | | | |
| Total, 1937 | | 367,468.00 | 7,932,095 | 28,342,000 | 18,910,000 | 9,106,000 |
| | | 368,905.00 | 6,260,693 | 21,868,000 | 19,572,000 | 8,494,000 |

[1] Quicksilver purchased (which is close to amount used) by amalgamation mills was 5,193 pounds. Placer mines used approximately 400 pounds.
[2] Cyanide (in terms of 96- to 98-percent NaCN) used was 769,920 pounds.
[3] Comprises 361,177 tons of sands and slimes from ore and iron concentrates first roasted and amalgamated, 195,013 tons of tailings from ore first floated, and 35,007 tons of combined flotation and table concentrates and crude ore cyanided direct.

Owing to changing sources of ore supply and the variance in character and grade of ore produced in different levels of some individual mines many problems in metallurgy occur, and changes in flow sheets of mills constantly are being made; some of the mills are dismantled and new ones built. The mills in operation in Colorado in 1938 varied greatly in size—61 having capacities ranging from 35 to 2,000 tons daily and 32 from 3 to 30 tons daily. Available data on the status of the 61 larger mills show that 11 were new mills that started operations during the year; 20 operated part of the year but were later shut down and were idle as the year ended; 6 were enlarged; and 24 re-



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ported no change. All but 5 of the smaller mills were run intermittently, and only 7 treated more than 1,000 tons of ore during the year.

The total ore treated in 1938 by all mills in Colorado handling ores of gold, silver, copper, lead, and zinc was 1,615,755 tons, of which 1,004,840 tons were treated in company mills at mines; 524,177 tons by the Golden Cycle custom roast-amalgamation-cyanidation-flotation mill at Colorado Springs; and 86,738 tons by custom flotation mills in or near the mining districts (some of which also treated company ore included above), comprising the following: The Mining Associates mill at Salina, Boulder Ore Sampling Works at Boulder (ore reshipped to Golden Cycle mill), and Colorado Smelting & Refining Co. plant at Marshall, all in Boulder County; Hoosac, Humboldt, and Ruth mills in the Idaho Springs district, Dumont mill at Dumont, and Silver Leaf (Watrous) mill at Silver Plume, all in Clear Creek County; Bolen and Golden Gilpin mills in Gilpin County; First National and H. G. N. in the Leadville district, Lake County; Creede Mills, Inc., at Creede, Mineral County; W. C. H. mill at Bonanza, Saguache County; and Shenandoah-Dives mill in San Juan County. All the foregoing custom mills except the Shenandoah-Dives treated only gold, gold-silver, silver, or silver-lead-gold-copper ores. Zinc-lead ore containing gold and silver from Chaffee, Clear Creek, Dolores, Hinsdale, Lake, San Juan, and Summit Counties was shipped to custom mills at Midvale and Tooele, Utah.

Direct-smelting ores comprised 19 percent of the State total ore in 1938. The Arkansas Valley lead bullion-leady copper matte smelter at Leadville purchased most of the gold, gold-silver, silver, and gold-silver-lead-copper ores and concentrates shipped to smelters during the year; the remainder was shipped to smelters in other States, as follows: Zinc ore from Gunnison County to Coffeyville, Kans.; zinc concentrates from Lake, Pitkin, and San Juan Counties to Amarillo, Tex.; iron-copper-silver-gold ore from Eagle County, copper-gold-silver concentrates from Clear Creek County, copper-silver ore from Montrose County, and gold-silver-lead and gold-silver-lead-copper ores and concentrates from the San Juan region to Utah smelters; and copper-gold-silver concentrates from San Juan County to El Paso, Tex.

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*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1938, by counties, in terms of recovered metals*

| County | Ore treated | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Boulder | 54,018 | 13,837.90 | 6,568 | 2,158 | 3,384.38 | 20,495 | 74,000 | 141,455 |
| Chaffee | 16 | 4.30 | | | | | | |
| Clear Creek | 207,892 | 23,489.63 | 7,750 | 9,370 | 8,327.62 | 66,271 | 389,285 | 434,097 |
| Custer | 1,500 | 142.20 | 1,083 | | | | | |
| Eagle | 60 | 2.65 | | | | | | |
| Gilpin | 46,444 | 3,676.42 | 12,933 | 2,875 | 1,752.77 | 9,211 | 16,400 | 44,138 |
| Gunnison | 6,182 | 728.00 | 473 | 79 | 55.61 | 1,362 | | 4,000 |
| Lake | 11,266 | 862.59 | 4,088 | 504 | 822.30 | 3,508 | 270 | 26,740 |
| La Plata | 14 | 29.17 | 236 | | | | | |
| Larimer | 11 | 22.20 | 34 | | | | | |
| Montezuma | 10 | 884.08 | 232 | | | | | |
| Ouray | 26,095 | 7,608.38 | 2,135 | 3,372 | 3,955.61 | 89,657 | 362,500 | 402,150 |
| Park | 30,920 | 964.93 | 29,160 | 1,019 | 3,382.50 | 2,975 | 1,600 | 100,840 |
| Rio Grande | 37,192 | 9,648.12 | 27,461 | 1,805 | 10,075.79 | 23,348 | 10,000 | |
| Saguache | 361 | 33.50 | 5 | 18 | 63.90 | 26 | | |
| San Juan | 190 | 165.42 | 89 | | | | | |
| San Miguel | 73,791 | 5,032.82 | 6,399 | 7,909 | 7,760.53 | 218,455 | 2,300 | 1,397,700 |
| Teller | 495,515 | 144,883.50 | 15,317 | | | | | |
| | 991,477 | 212,015.81 | 113,963 | 29,109 | 39,581.01 | 435,308 | 856,355 | 2,551,120 |
| Total, 1937 | 941,765 | 200,337.92 | 78,217 | 22,668 | 31,408.96 | 277,360 | 642,445 | 1,694,970 |

*Mine production of metals from concentrating mills in Colorado in 1938, by counties, in terms of recovered metals*

| County | Ore treated | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|
| | | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Boulder | 24,790 | 2,282 | 5,307.97 | 10,824 | 9,800 | 21,495 | |
| Chaffee | 172 | 91 | 75.90 | 987 | 3,600 | 42,600 | 48,000 |
| Clear Creek | 15,048 | 1,366 | 1,023.08 | 43,512 | 25,365 | 153,993 | 17,000 |
| Conejos | 500 | 26 | 12.60 | 916 | | | |
| Dolores | 310 | 104 | 15.88 | 1,292 | 2,200 | 37,200 | 60,000 |
| Gilpin | 3,898 | 313 | 196.74 | 7,797 | 500 | 35,070 | |
| Gunnison | 375 | 13 | 5.79 | 158 | | 1,440 | |
| Hinsdale | 1,271 | 180 | 26.90 | 5,183 | 6,380 | 136,400 | 6,000 |
| Lake | 14,843 | 1,417 | 916.03 | 10,505 | 4,840 | 427,350 | 193,000 |
| La Plata | 2,980 | 37 | 187.70 | 1,683 | | 1,800 | |
| Mineral | 35,179 | 937 | 187.20 | 441,092 | | 229,300 | |
| Ouray | 27,474 | 1,478 | 721.90 | 66,802 | 348,900 | 313,150 | |
| Park | 97,868 | 6,562 | 26,438.05 | 20,283 | 49,220 | 606,160 | |
| Pitkin | 14,500 | 741 | | 88,379 | 500 | 265,600 | 160,000 |
| Saguache | 1,400 | 246 | 16.10 | 4,465 | 14,800 | 47,100 | |
| San Juan | 331,053 | 27,340 | 24,007.32 | 627,739 | 2,016,700 | 7,934,500 | 8,549,000 |
| San Miguel | 50,679 | 5,254 | 3,678.90 | 236,528 | 131,500 | 706,214 | |
| Summit | 2,116 | 297 | 2.47 | 14,093 | 430 | 248,670 | 31,000 |
| Teller | 2,842 | 100 | 302.10 | 175 | | | |
| | 627,298 | 48,784 | 63,122.63 | 1,582,413 | 2,614,735 | 11,208,042 | 9,064,000 |
| Total, 1937 | 801,391 | 55,977 | 93,165.27 | 1,122,202 | 1,712,782 | 11,880,481 | 6,577,000 |

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*Gross metal content of concentrates produced from ores mined in Colorado in 1938, by classes of concentrates smelted*

| Class of concentrates | Concentrates produced | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper (wet assay) | Lead (wet assay) | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 19,762 | 54,494.17 | 99,934 | 217,098 | 1,103,323 | 671,886 |
| Dry gold-silver | 720 | 403.26 | 7,566 | 4,573 | 30,620 | 10,647 |
| Dry silver | 61 | 16.19 | 7,027 | 810 | 3,422 | 6,000 |
| Copper | 6,645 | 4,532.26 | 93,879 | 1,024,362 | 141,122 | 137,854 |
| Lead | 29,132 | 20,842.91 | 1,344,401 | 930,570 | 11,602,241 | 2,793,938 |
| Lead-copper | 10,803 | 21,887.06 | 428,937 | 1,818,752 | 2,457,453 | 1,637,564 |
| Zinc | 10,770 | 756.16 | 59,233 | 154,597 | 817,996 | 10,637,650 |
| | 77,893 | 102,932.01 | 2,040,977 | 4,150,762 | 16,156,177 | 15,895,539 |
| Total, 1937 | 78,645 | 124,631.02 | 1,411,898 | 2,833,995 | 15,683,798 | 14,380,882 |

*Mine production of metals from Colorado concentrates shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Boulder | 4,440 | 8,692.35 | 31,319 | 83,800 | 162,950 | ---------- |
| Chaffee | 91 | 75.90 | 987 | 3,600 | 42,600 | 48,000 |
| Clear Creek | 10,736 | 9,350.70 | 109,783 | 414,650 | 588,090 | 17,000 |
| Conejos | 26 | 12.60 | 916 | ---------- | ---------- | ---------- |
| Dolores | 104 | 15.88 | 1,292 | 2,200 | 37,200 | 60,000 |
| Gilpin | 3,188 | 1,949.51 | 17,008 | 16,900 | 79,208 | ---------- |
| Gunnison | 92 | 61.40 | 1,520 | ---------- | 5,440 | ---------- |
| Hinsdale | 180 | 26.90 | 5,183 | 6,380 | 136,400 | 6,000 |
| Lake | 1,921 | 1,738.33 | 14,013 | 5,110 | 454,090 | 193,000 |
| La Plata | 37 | 187.70 | 1,683 | ---------- | 1,800 | ---------- |
| Mineral | 937 | 187.20 | 441,092 | ---------- | 229,300 | ---------- |
| Ouray | 4,850 | 4,677.51 | 156,459 | 711,400 | 715,300 | ---------- |
| Park | 7,581 | 29,820.55 | 23,258 | 50,820 | 707,000 | ---------- |
| Pitkin | 741 | ---------- | 88,379 | 500 | 265,600 | 160,000 |
| Rio Grande | 1,805 | 10,075.79 | 23,348 | 10,000 | ---------- | ---------- |
| Saguache | 264 | 80.00 | 4,491 | 14,800 | 47,100 | ---------- |
| San Juan | 27,340 | 24,007.32 | 627,739 | 2,016,700 | 7,934,500 | 8,549,000 |
| San Miguel | 13,163 | 11,439.43 | 454,983 | 133,800 | 2,103,914 | ---------- |
| Summit | 297 | 2.47 | 14,093 | 430 | 248,670 | 31,000 |
| Teller | 100 | 302.10 | 175 | ---------- | ---------- | ---------- |
| | 77,893 | 102,703.64 | 2,017,721 | 3,471,090 | 13,759,162 | 9,064,000 |
| Total, 1937 | 78,645 | 124,574.23 | 1,399,562 | 2,355,227 | 13,575,451 | 6,577,000 |

BY CLASSES OF CONCENTRATES SMELTED

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 19,762 | 54,494.17 | 99,915 | 174,122 | 988,548 | ---------- |
| Dry gold-silver | 720 | 403.26 | 7,566 | 3,700 | 26,647 | ---------- |
| Dry silver | 61 | 16.19 | 7,027 | 650 | 3,000 | ---------- |
| Copper | 6,645 | 4,532.26 | 93,879 | 967,300 | 77,700 | ---------- |
| Lead | 29,132 | 20,842.91 | 1,344,401 | 744,930 | 10,432,324 | ---------- |
| Lead-copper | 10,803 | 21,887.06 | 428,937 | 1,456,788 | 2,214,638 | ---------- |
| Zinc | 10,770 | 527.79 | 35,996 | 123,600 | 16,305 | 9,064,000 |
| | 77,893 | 102,703.64 | 2,017,721 | 3,471,090 | 13,759,162 | 9,064,000 |

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*Gross metal content of Colorado crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | | Gross metal content | | | | |
|---|---|---|---|---|---|---|---|
| | | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Percent of total* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 12,086 | 3.21 | 10,756.28 | 39,461 | 88,439 | 218,598 | 12,013 |
| Dry and siliceous gold-silver | 2,047 | .54 | 516.49 | 28,351 | 3,767 | 144,984 | 15,998 |
| Dry and siliceous silver | 15,443 | 4.09 | 26.67 | 167,598 | 9,626 | 268,573 | ---------- |
| Copper | 333,103 | 88.28 | 17,131.25 | 5,421,143 | 25,554,350 | 3,573,176 | 6,001,013 |
| Lead | 14,459 | 3.83 | 6,255.63 | 140,159 | 42,258 | 2,890,935 | 127,599 |
| Lead-copper | 37 | .01 | 9.36 | 366 | 3,019 | 6,901 | 6,982 |
| Zinc | 145 | .04 | 11.87 | 83 | ---------- | 4,190 | 50,836 |
| | 377,320 | 100.00 | 34,707.55 | 5,797,161 | 25,701,459 | 7,107,357 | 6,214,441 |
| Total, 1937 | 325,463 | 100.00 | 29,125.71 | 4,780,468 | 20,140,977 | 7,743,622 | 7,758,837 |

*Mine production of metals from Colorado crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Boulder | 103 | 87.15 | 842 | 1,200 | 1,050 | ---------- |
| Chaffee | 622 | 139.00 | 3,810 | 800 | 169,400 | ---------- |
| Clear Creek | 671 | 392.87 | 12,587 | 8,350 | 96,910 | 13,000 |
| Custer | 49 | 2.80 | 1,689 | ---------- | 24,000 | ---------- |
| Dolores | 83 | 36.92 | 3,635 | 1,200 | 19,800 | ---------- |
| Eagle | 327,681 | 17,424.35 | 5,307,342 | 24,026,000 | 1,865,000 | ---------- |
| Fremont | 64 | 4.20 | 34 | 9,400 | ---------- | ---------- |
| Garfield | 103 | 157.80 | 68 | 100 | ---------- | ---------- |
| Gilpin | 240 | 203.07 | 3,569 | 6,100 | 21,792 | ---------- |
| Gunnison | 246 | 33.60 | 2,937 | 100 | 13,560 | 29,000 |
| Hinsdale | 12 | .50 | 313 | 120 | 4,600 | ---------- |
| Lake | 21,657 | 7,628.48 | 87,133 | 51,890 | 1,994,910 | ---------- |
| La Plata | 2 | 5.33 | 16 | 100 | 100 | ---------- |
| Mineral | 477 | ---------- | 16,503 | ---------- | 11,700 | ---------- |
| Montezuma | 672 | 1,006.72 | 3,363 | 3,000 | 100 | ---------- |
| Montrose | 119 | 1.80 | 549 | 13,600 | ---------- | ---------- |
| Ouray | 850 | 465.51 | 54,785 | 12,100 | 136,700 | ---------- |
| Park | 1,317 | 3,323.52 | 3,616 | 4,180 | 131,000 | ---------- |
| Pitkin | 13,435 | .60 | 102,199 | ---------- | 174,400 | ---------- |
| Rio Grande | 15 | 44.69 | 46 | ---------- | ---------- | ---------- |
| Saguache | 6,596 | 144.50 | 120,329 | 721,200 | 179,900 | ---------- |
| San Juan | 482 | 2,338.26 | 19,884 | 4,300 | 76,500 | ---------- |
| San Miguel | 449 | 598.35 | 10,282 | 4,200 | 136,086 | ---------- |
| Summit | 1,375 | 667.53 | 41,630 | 2,970 | 93,330 | ---------- |
| | 377,320 | 34,707.55 | 5,797,161 | 24,870,910 | 5,150,838 | 42,000 |
| Total, 1937 | 325,463 | 29,121.85 | 4,780,349 | 19,512,773 | 5,996,549 | 1,917,000 |

BY CLASSES OF ORE

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry and siliceous gold | 12,086 | 10,756.28 | 39,461 | 74,760 | 195,484 | ---------- |
| Dry and siliceous gold-silver | 2,047 | 516.49 | 28,351 | 2,750 | 129,806 | ---------- |
| Dry and siliceous silver | 15,443 | 26.67 | 167,598 | 7,890 | 241,265 | ---------- |
| Copper | 333,103 | 17,131.25 | 5,421,143 | 24,750,110 | 1,960,667 | ---------- |
| Lead | 14,459 | 6,255.63 | 140,159 | 32,900 | 2,615,116 | ---------- |
| Lead-copper | 37 | 9.36 | 366 | 2,500 | 6,200 | ---------- |
| Total to copper and lead plants | 377,175 | 34,695.68 | 5,797,078 | 24,870,910 | 5,148,538 | ---------- |
| Zinc | 145 | 11.87 | 83 | ---------- | 2,300 | 42,000 |
| | 377,320 | 34,707.55 | 5,797,161 | 24,870,910 | 5,150,838 | 42,000 |

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, by counties and districts, in terms of recovered metals*

| County and district | Mines producing | | Ore sold or treated | Gold | | | Silver | | | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Adams County | | 11 | | | 91.80 | 91.80 | | 14 | 14 | | | | $3,222 |
| Arapahoe County | | 8 | | | 20.00 | 20.00 | | 1 | 1 | | | | 701 |
| Boulder County: | | | | | | | | | | | | | |
| Central | 16 | | 7,468 | 4,020.60 | | 4,020.60 | 475 | | 475 | | | | 141,028 |
| Gold Hill | 65 | 3 | 55,926 | 11,782.80 | 4.20 | 11,787.00 | 31,779 | | 31,779 | 78,800 | 153,500 | | 447,872 |
| Grand Island | 8 | 4 | 2,350 | 402.00 | 9.40 | 411.40 | 2,421 | | 2,421 | | 8,500 | | 16,355 |
| Magnolia | 15 | | 1,821 | 824.00 | | 824.00 | 14 | | 14 | | | | 28,849 |
| Sugar Loaf | 29 | 4 | 9,066 | 3,861.20 | 418.40 | 4,279.60 | 2,221 | 34 | 2,255 | 3,000 | 1,000 | | 151,584 |
| Ward | 21 | | 2,280 | 1,726.80 | | 1,726.80 | 1,819 | | 1,819 | 3,200 | 1,000 | | 61,974 |
| Chaffee County: | | | | | | | | | | | | | |
| Chalk Creek | 1 | | 248 | 137.20 | | 137.20 | 1,778 | | 1,778 | 4,400 | 57,700 | 48,000 | 11,340 |
| Granite | 3 | 16 | 22 | 18.80 | 253.20 | 272.00 | 31 | 37 | 68 | | 1,000 | | 9,610 |
| Monarch | 5 | | 517 | 43.40 | | 43.40 | 2,931 | | 2,931 | | 151,300 | | 10,374 |
| Riverside | 1 | | 12 | 17.80 | | 17.80 | 57 | | 57 | | 2,000 | | 752 |
| Trout Creek | 1 | | 11 | 2.00 | | 2.00 | | | | | | | 70 |
| Clear Creek County: | | | | | | | | | | | | | |
| Alice and Empire | 16 | 2 | 151,128 | 23,401.00 | 5.40 | 23,406.40 | 32,005 | | 32,005 | 306,800 | 3,900 | | 870,159 |
| Argentine | 2 | | 3,043 | 313.80 | | 313.80 | 11,863 | | 11,863 | 12,200 | 36,000 | | 21,504 |
| Griffith | 9 | 1 | 6,961 | 318.60 | 1.00 | 319.60 | 18,369 | | 18,369 | 3,500 | 46,300 | | 25,534 |
| Idaho Springs | 53 | 44 | 46,671 | 5,737.60 | 88.80 | 5,826.40 | 49,486 | 14 | 49,500 | 46,200 | 520,500 | 17,000 | 265,211 |
| Montana | 10 | | 6,677 | 1,164.20 | | 1,164.20 | 12,389 | | 12,389 | 49,300 | 27,000 | | 54,829 |
| Trail Creek | 7 | | 9,131 | 2,298.00 | | 2,298.00 | 6,008 | | 6,008 | 5,000 | 51,300 | 13,000 | 87,788 |
| Conejos County | 1 | | 500 | 12.60 | | 12.60 | 916 | | 916 | | | | 1,033 |
| Costilla County: Grayback | | 2 | | | 13.80 | 13.80 | | 3 | 3 | | | | 485 |
| Custer County: Hardscrabble | 3 | | 1,549 | 145.00 | | 145.00 | 2,772 | | 2,772 | | 24,000 | | 7,971 |
| Denver County | | 9 | | | 7.40 | 7.40 | | | | | | | 259 |
| Dolores County: | | | | | | | | | | | | | |
| Lone Cone | 1 | | 173 | 18.51 | | 18.51 | 285 | | 285 | | | | 832 |
| Pioneer | 3 | 4 | 220 | 34.29 | 6.00 | 40.29 | 4,642 | | 4,642 | 3,400 | 57,000 | 60,000 | 10,246 |
| Douglas County | | 15 | | | 41.20 | 41.20 | | | | | | | 1,442 |
| Eagle County: | | | | | | | | | | | | | |
| Burns-McCoy | | 7 | | | 18.20 | 18.20 | | | | | | | 637 |
| Holy Cross | 1 | | 63 | 6.20 | | 6.20 | | | | | | | 217 |
| Redcliff | 9 | | 327,678 | 17,420.80 | | 17,420.80 | 5,307,342 | | 5,307,342 | 24,026,000 | 1,865,000 | | 6,481,075 |
| Elbert County | | 4 | | | 17.40 | 17.40 | | | | | | | 609 |
| Fremont County | 2 | 1 | 64 | 4.20 | 6.00 | 10.20 | 34 | 1 | 35 | 9,400 | | | 1,301 |
| Garfield County | 1 | | 103 | 157.80 | | 157.80 | 68 | | 68 | 100 | | | 5,577 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gilpin County: | | | | | | | | | | | | | |
| Southern | 54 | 141 | 40,523 | 4,487.40 | 5,066.20 | 9,553.60 | 32,291 | 1,092 | 33,383 | 22,200 | 81,000 | | 361,859 |
| Northern | 11 | 11 | 10,059 | 1,341.60 | 3,270.20 | 4,611.80 | 1,219 | 294 | 1,513 | 800 | 20,000 | | 163,389 |
| Grand County | | 2 | | | 2.00 | 2.00 | | | | | | | 70 |
| Gunnison County: | | | | | | | | | | | | | |
| Box Canyon | 1 | | 225 | 19.60 | | 19.60 | 3 | | 3 | | | | 688 |
| Elk Mountain | 2 | 1 | 50 | 2.60 | .60 | 3.20 | 167 | | 167 | | 1,300 | | 280 |
| Gold Brick | 6 | | 6,349 | 791.20 | | 791.20 | 2,571 | | 2,571 | | 9,300 | | 29,782 |
| Quartz Creek | 1 | | 46 | 6.00 | | 6.00 | 2,189 | | 2,189 | 100 | 7,500 | | 1,980 |
| Spring Gulch | 1 | | 93 | | | | | | | | 900 | 29,000 | 1,433 |
| Taylor Park (Tin Cup) | 1 | 3 | 40 | 3.60 | 5.20 | 8.80 | | | | | | | 308 |
| Hinsdale County: | | | | | | | | | | | | | |
| Galena | 3 | | 1,183 | 25.40 | | 25.40 | 4,908 | | 4,908 | 5,850 | 137,000 | 6,000 | 11,225 |
| Lake | 1 | | 100 | 2.00 | | 2 00 | 588 | | 588 | 650 | 4,000 | | 698 |
| Jackson County | | 1 | | | 1.20 | 1.20 | | | | | | | 42 |
| Jefferson County | | 35 | | | 71.80 | 71.80 | | 14 | 14 | | | | 2,522 |
| Lake County: | | | | | | | | | | | | | |
| California (Leadville) | 58 | 8 | 45,474 | 10,044.80 | 13.60 | 10,058.40 | 101,472 | 3 | 101,475 | 56,800 | 2,444,900 | 193,000 | 544,939 |
| Other districts [1] | 7 | 14 | 2,292 | 184.60 | 1,750.00 | 1,934.60 | 3,762 | 424 | 4,186 | 200 | 4,100 | | 70,626 |
| La Plata County: | | | | | | | | | | | | | |
| Animas River | | 2 | | | 7.40 | 7.40 | | | | | | | 259 |
| California | 6 | | 2,996 | 222.20 | | 222.20 | 1,935 | | 1,935 | 100 | 1,900 | | 9,125 |
| Larimer County | 1 | | 11 | 22.20 | | 22.20 | 34 | | 34 | | | | 799 |
| Mineral County: Creede | 7 | | 35,656 | 187.20 | | 187.20 | 457,595 | | 457,595 | | 241,000 | | 313,457 |
| Moffat County: Fourmile (Timberlake) | | 11 | | | 640.60 | 640.60 | | 31 | 31 | | | | 22,441 |
| Montezuma County | 3 | 1 | 682 | 1,890.80 | .80 | 1,891.60 | 3,595 | | 3,595 | 3,000 | 100 | | 68,829 |
| Montrose County: | | | | | | | | | | | | | |
| La Sal | 2 | 3 | 119 | 1.80 | 40.20 | 42.00 | 549 | 11 | 560 | 13,600 | | | 3,165 |
| Naturita | | 12 | | | 25.60 | 25.60 | | 8 | 8 | | | | 901 |
| Ouray County: | | | | | | | | | | | | | |
| Red Mountain | 2 | | 22,517 | 699.80 | | 699.80 | 37,363 | | 37,363 | 348,000 | 281,400 | | 95,695 |
| Ridgway | | 3 | | | 9.20 | 9.20 | | 3 | 3 | | | | 324 |
| Sneffels | 3 | | 25,118 | 11,508.60 | | 11,508.60 | 92,537 | | 92,537 | 362,000 | 402,300 | | 516,605 |
| Uncompahgre | 8 | | 6,784 | 543.00 | | 543.00 | 83,479 | | 83,479 | 13,500 | 168,300 | | 82,036 |
| Park County: | | | | | | | | | | | | | |
| Alma Placers | | 61 | | | 3,213.40 | 3,213.40 | | 662 | 662 | | | | 112,897 |
| Beaver Creek | | 6 | | | 403.00 | 403.00 | | 87 | 87 | | | | 14,161 |
| Buckskin | 5 | 4 | 608 | 304.40 | 8.80 | 313.20 | 993 | 1 | 994 | 150 | 20,400 | | 12,558 |
| Consolidated Montgomery | 2 | 2 | 5,929 | 278.20 | 39.20 | 317.40 | 29,007 | 8 | 29,015 | | | | 29,866 |
| Fairplay | | 18 | | | 167.00 | 167.00 | | 36 | 36 | | | | 5,868 |
| Horseshoe | 1 | | 11 | .20 | | .20 | 147 | | 147 | | 3,000 | | 240 |
| Mosquito | 10 | 1 | 123,557 | 33,526.20 | 17.60 | 33,543.80 | 25,887 | 4 | 25,891 | 54,850 | 814,600 | | 1,233,618 |
| Tarryall | | 25 | | | 730.20 | 730.20 | | 59 | 59 | | | | 25,595 |
| Pitkin County: | | | | | | | | | | | | | |
| Lincoln Gulch | 1 | | 1 | .60 | | .60 | 9 | | 9 | | | | 27 |
| Roaring Fork | 4 | | 27,934 | | | | 190,569 | | 190,569 | 500 | 440,000 | 160,000 | 151,165 |
| Rio Grande County: Summitville | 2 | | 37,207 | 19,768.60 | | 19,768.60 | 50,855 | | 50,855 | 10,000 | | | 725,757 |

[1] Includes Granite, Independence, Lackawanna Gulch, St. Kevin, Tennessee Pass, and Twin Lakes districts.

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*Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore sold or treated | Gold | | | Silver | | | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Routt County: Hahns Peak | ------ | 4 | ---------- | ---------- | 41.00 | 41.00 | ---------- | 19 | 19 | ---------- | ---------- | ---------- | $1,447 |
| Saguache County: | | | | | | | | | | | | | |
| Blake | 2 | -------- | 7 | 1.80 | ---------- | 1.80 | 3 | ---------- | 3 | 500 | ---------- | ---------- | 114 |
| Crestone | 2 | -------- | 361 | 97.40 | ---------- | 97.40 | 31 | ---------- | 31 | ---------- | ---------- | ---------- | 3,429 |
| Kerber Creek | 7 | -------- | 7,989 | 158.80 | ---------- | 158.80 | 124,791 | ---------- | 124,791 | 735,500 | 227,000 | ---------- | 168,752 |
| San Juan County: | | | | | | | | | | | | | |
| Animas | 17 | 2 | 219,194 | 20,640.40 | 4.60 | 20,645.00 | 377,366 | ---------- | 377,366 | 1,360,600 | 1,992,600 | 263,000 | 1,204,152 |
| Eureka | 3 | -------- | 112,358 | 5,841.00 | ---------- | 5,841.00 | 267,953 | ---------- | 267,953 | 660,000 | 5,982,700 | 8,286,000 | 1,115,269 |
| Ice Lake Basin | 1 | -------- | 173 | 29.60 | ---------- | 29.60 | 2,393 | ---------- | 2,393 | 400 | 35,700 | ---------- | 4,264 |
| San Miguel County: | | | | | | | | | | | | | |
| Iron Springs | 7 | 1 | 16,322 | 1,125.60 | 11.00 | 1,136.60 | 145,360 | 5 | 145,365 | 62,800 | 468,800 | ---------- | 161,473 |
| Lower San Miguel | ------ | 5 | ---------- | ---------- | 6.20 | 6.20 | ---------- | 3 | 3 | ---------- | ---------- | ---------- | 219 |
| Mount Wilson | 4 | -------- | 29 | 99.00 | ---------- | 99.00 | 153 | ---------- | 153 | 200 | 300 | ---------- | 3,598 |
| Upper San Miguel | 13 | 7 | 108,568 | 15,846.00 | 46.60 | 15,892.60 | 326,151 | 17 | 326,168 | 75,000 | 1,770,900 | ---------- | 855,908 |
| Summit County: | | | | | | | | | | | | | |
| Breckenridge | 8 | 61 | 1,020 | 427.20 | 1,414.80 | 1,842.00 | 27,166 | 362 | 27,528 | 850 | 43,700 | 21,000 | 85,367 |
| Montezuma | 7 | -------- | 2,124 | 4.00 | ---------- | 4.00 | 16,284 | ---------- | 16,284 | 2,550 | 259,000 | 10,000 | 23,311 |
| Ten Mile | 3 | 1 | 138 | 165.80 | 1.00 | 166.80 | 458 | ---------- | 458 | ---------- | 23,800 | ---------- | 7,229 |
| Wilkinson | 3 | -------- | 209 | 73.00 | ---------- | 73.00 | 11,815 | ---------- | 11,815 | ---------- | 15,500 | ---------- | 10,906 |
| Teller County: Cripple Creek | 106 | 11 | 498,357 | 145,185.60 | 29.80 | 145,215.40 | 15,492 | 3 | 15,495 | ---------- | ---------- | ---------- | 5,092,556 |
| Total Colorado | 669 | 592 | 1,996,095 | 349,427.00 | 18,041.00 | 367,468.00 | 7,928,845 | 3,250 | 7,932,095 | 28,342,000 | 18,910,000 | 9,106,000 | 22,073,663 |

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### ADAMS COUNTY

A sluice within the No. 10 gravel-washing plant of the Brannan Sand & Gravel Co. on Clear Creek north of Denver recovered gold as a byproduct in 1938. Individuals who, with one or two exceptions, engaged in placering along Clear Creek as a spare-time activity recovered many small lots of placer gold which they sold to dealers in Denver. Sluicing of stream gravel on the Russell ranch in sec. 14, T. 2 S., R. 68 W., sixth principal meridian, yielded 4.98 crude ounces of placer gold averaging 0.909 fine in gold and 0.044 fine in silver.

### ARAPAHOE COUNTY

In 1938 placer operations by individuals on Cherry and Dry Creeks and their tributaries southeast of Denver recovered small lots of gold dust and amalgam retorts, which were sold to dealers in Denver.

### BOULDER COUNTY

The principal market for Boulder County ores in 1938 continued to be the Golden Cycle mill at Colorado Springs and for concentrates the A. V. smelter at Leadville. Carey & Weldon reopened the Boulder Ore Sampling Works April 1 and to the end of the year purchased ore for reshipment to the Golden Cycle mill. The Colorado Smelting & Refining Co. custom mill built near Marshall in 1937 was operated for a few months in 1938 before being placed in the hands of a receiver. Boulder County, as usual, had more producing lode mine operations than any other county in the State; however, many of those counted are prospects and dumps, inactive mines under investigation, and others producing in general less than 25 tons of ore. Space does not permit mention of these operations in the following review by districts.

*Central (Jamestown) district.*—The Wano mine at Jamestown was the principal gold producer in the Central district in 1938 and was next to the largest individual producing mine in Boulder County; it was operated by the owner and several sets of split-check lessees, who shipped the ore to the Golden Cycle mill at Colorado Springs. The other producers of a car or more of ore in the district were the Gold Finch, Golden Age, Grouse, Rip Van Dam, and Smuggler.

*Gold Hill district.*—Slide Mines, Inc., operated its Slide-Klondike group of mines continuously in 1938 and was the largest producer of gold, silver, lead, and copper in Boulder County. The ore is treated in the company 70-ton mill, which uses both the gravity- and flotation-concentration processes. Free gold caught on burlap tables between the classifier and Wilfley tables was amalgamated and shipped to the Denver Mint. Most of the gold and silver and all the copper and lead recovered were contained in concentrates shipped to the Leadville smelter. Mining Associates, Inc., continued to purchase ore from operators in Boulder County for treatment in its custom flotation mill at Salina. The Ingram mine, operated by the company, supplied the largest individual tonnage to the mill. The company also operated the Sunshine mine under lease after September 10. Approximately 10,000 tons of low-grade ore were shipped from the King group in 1938; the ore produced from September to December was treated in the St. Joe mill at Valmont, and the remainder was sold to custom

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plants. Among other producing mines and dumps in the Gold Hill district in 1938 were the American-Osceola, Black Bird-White Eagle group, Black Cloud, Buena Ventura, Cash, Cold Spring, Dead Medicine, Emancipation, Evans, Evening Star, Fisk, Golden Crown, Golden Harp, Grant, Hawkeye, J. O., Little Johnny, Melvina dump, Nil Desperandum, Pilot, Plow Boy, Richard, Richmond, Scotia, Sun & Moon, Tammany, and Washburn.

*Grand Island district.*—The output from the Grand Island district in 1938 comprised ore shipped to custom plants from the Amy Paul mine, Bird's Nest-Village Belle group, Caribou, Cross group, Enterprise group, Huron claim, and Shirley group; ore concentrated by gravity in a 20-ton mill at the Norway mine; and a little gold recovered by placer miners on Beaver and South Boulder Creeks.

*Magnolia district.*—The American X, Ben C. Lowell, Cash-Rebecca, KeKeOnga, Senator Hill, Pickwick, Poorman, and Sac and Fox-Dunraven groups produced nearly all the ore shipped from the Magnolia district in 1938. The mill at the Keystone mine was repaired, and some ore was treated to test the equipment.

*Sugar Loaf district.*—In 1938 the Poorman group, worked by lessees, continued to be the largest producer of gold in the Sugar Loaf district. Most of the ore was shipped to the Golden Cycle mill. Lessees at the Grand Republic mine shipped 1,550 tons of ore to custom plants, chiefly to the Mining Associates mill at Salina. The other principal producing mines and dumps in the district were the Alpine Horn, Concord, Dime, Dolly Varden, Empress, Herold, Livingston, Logan, Nancy, Recluse, Red Signe, Three Brothers, and Wood Mountain. Ore from the Orphan Boy mine was treated in a small mill above Wallstreet, run for a period in 1938. A dragline and sluicing plant operated on the Giggy placer produced nearly all the district output of placer gold.

*Ward district.*—The B & M mine was the principal producer in the Ward district in 1938. It was operated under a lease from January 1 to November 15 by Larson & Johnson, who shipped 460 tons of ore containing 610 ounces of gold and 723 ounces of silver. These operators sank a shaft 83 feet and drove 250 feet of drifts. The lease was then transferred to Kissell & Co., who continued production and development to the end of the year. The Brock No. 5, Golden Queen, and Boston mines and the Humboldt and Grandview dumps produced nearly all the remainder of the district output.

## CHAFFEE COUNTY

*Chalk Creek district (Romley, St. Elmo).*—Lessees working the Mary Murphy mine on a small scale continued in 1938 to ship ore containing gold, silver, lead, and copper and a relatively high percentage of zinc to the Midvale (Utah) custom milling plant and selected ore of similar type, but lower in zinc content, to the Leadville (Colo.) smelter.

*Granite district.*—Only a few lots of ore were shipped from lode mines and prospects in the Granite district of Chaffee County in 1938. Two placer mines in Lost Canyon—the Independent and Lost Canon—each worked with a dragline and land washing and sluicing plant produced most of the placer gold shipped from the district during the year. Individuals recovered small lots of placer dust by sluicing along Arkansas River and Cache Creek.

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*Monarch district.*—The quantity of lead-silver-gold ore shipped to the Leadville smelter in 1938 from mines in the Monarch district increased over 1937. The Lilly mine, which produced most of the ore, was operated by lessees nearly all the year. Several shipments were made from the Christmas of '98, Garfield, and New York claims. The Hawkeye mine, under development from September 1 to December 31, yielded 10 tons of ore.

*Riverside district.*—The Doris Ruby Mining Co. shipped 12 tons of gold-silver-lead ore to the Leadville smelter in 1938.

*Trout Creek district.*—A little gold was recovered by hand methods at the Mizpah claim, on which 54 feet of development work were done in 1938.

### CLEAR CREEK COUNTY

*Alice district* (*Yankee, Lincoln*).—The American Smelting & Refining Co., which had operated the Alice group since March 4, 1936, continued operations in 1938 to October 22, when it closed the mine and 275-ton amalgamation-flotation mill indefinitely, owing to exhaustion of ore. In 1938, as in 1937, this mine was the second-largest producer of gold and the largest producer of copper in Clear Creek County. Ore mined by Gopher State Gold, Inc., lessees of the Ottawa group, was concentrated in the Hoosac mill near the junction of Fall River and Clear Creek. The Reynolds stamp-amalgamation mill was run for a short period in 1938 on ore from the Reynolds group. Ore was shipped to the Golden Cycle mill from the Gold King and Lombard mines, and a small lot was shipped to the Leadville smelter from the Ivan group.

*Argentine district.*—The upper levels of the Santiago mine were operated in 1938 by a lessee who shipped the ore to custom plants. The Dynamite Metals Co. operated the mill at the mine under lease from May 26 to June 12 on dump material and then gave up its lease. The Santiago Metals Corporation afterward ran the mill for 70 days on ore obtained mostly from the dump. Lessees operated the Sidney Tunnel group of the New East Argentine Mining & Milling Co. 4 months and produced 570 tons of silver-lead ore which were treated by Bennett & Rowe in the Silver Leaf mill at Silver Plume and 2 tons which were shipped direct to the Leadville smelter.

*Empire district.*—Minnesota Mines, Inc., the largest producer of gold in Clear Creek County in 1938, operated continuously its consolidated group of claims in the area north of Empire. The ore was treated in the 250-ton mill at the mine by concentration on mats in launders and flotation followed by cyanidation of the flotation concentrates. After being treated the flotation concentrates, containing chiefly iron sulfide, were sold to the General Chemical Co. of Denver. The mat concentrates, containing mostly free gold, were amalgamated. Lessees at the Tenth Legion-Gold Dirt-Sprankel-Empress Tunnel group shipped over 1,000 tons of ore, part of which was sold to the Golden Cycle mill at Colorado Springs and part concentrated in custom mills at Dumont and Idaho Springs. The Viking Gold Mines Corporation, lessee of the Conqueror group, subleased the property to Three Leasers, who operated it from July 15 to December 31 and made steady shipments of ore to the Golden Cycle mill. The other producers in the Empire district in 1938

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comprised the Bard Creek dump, Gold Bug mine, Gold Fissure, Mint, Omaha, Pittsburg, and Sturm.

*Griffith (Georgetown-Silver Plume) district.*—The H. G. Venable Co. reopened the Pulaski mine in July 1938 and operated it to the end of the year. The company drove 500 feet of drifts and raises, retimbered 400 feet of tunnel, and installed new rails for tramming. The output of ore (2,189 tons) was concentrated in the Silver Leaf custom mill at Silver Plume and the leased Commonwealth mill at Georgetown. During the first few months of the year the Commonwealth mill was used by the Griffith Leasing Co. to treat ore from the Griffith mine, which was closed later. Ore from the Corry City, Seven Thirty, and Wisconsin dumps was concentrated in the Silver Leaf mill and in the Ruth custom mill at Idaho Springs. Late in the year ore from the Capital Tunnel was shipped to the Ruth mill. A few lots of ore were shipped from other mines and prospects in the Griffith district, including the Johnny Bull, Mineral Chief, and Rio Grande. The Silver Plume Mining & Milling Co. remodeled the Terrible mill and repaired the tunnel portal between the mine and mill.

*Idaho Springs district.*—In 1938 the Alma-Lincoln Mining Co. treated 31,295 tons of gold-silver-lead-copper ore from its Elliott Barber-Lincoln group in its flotation mill. The company has been a consistent producer since October 18, 1933, in spite of having had serious difficulty in the disposal of tailings during the past 3 years. The Ruth custom mill continued operations on ores received from both Clear Creek and Gilpin Counties. The Humboldt Consolidated Mining Co. operated the flotation mill at the Clear Creek-Gilpin sampler on company and custom ore from January to April, when the company closed the mill and the Lord Byron mine; both remained idle to the end of 1938. Ore from the Dixie mine on Ute Creek was treated in a small amalgamation mill. The Colorado Custom Ore Millers treated ore from the Cardigan mine before suspending operations April 15. J. B. Furstenberg operated the Metropolitan mine and Hoosac mill under lease and treated 882 tons of his ore and 3,736 tons of custom ore from the other mines in Clear Creek County. The Black Eagle group and 60-ton flotation mill were operated for a short period early in the year. Ore was shipped to the Golden Cycle mill, A. V. smelter, Midvale (Utah) custom mill, and local custom mills from many other mines, prospects, and dumps in the Idaho Springs district, including the Bald Eagle mine, Calvin-Remington, Cardigan, Cardwell, Columbia-Summit, Crown Point-Virginia, Edward-Kunegunde, Golden Edge, Idaho Bride, Kangaroo, Red Jacket, Shafter, Stanley, Stephens Placer, and West Gold. Small sluicing operations along Clear Creek yielded placer gold.

*Montana district (Lawson, Dumont).*—The Clear Creek Consolidated Mining Co. erected a 150-ton flotation mill in 1938 at the portal of Clear Creek-Gilpin Tunnel to treat ore opened by the company development program carried on since 1936 in a group of claims traversed by the adit. The mill was started in June and was operated the rest of the year. The Dumont mill was used to concentrate some custom ore from the Gold Dirt group (Empire district), Jumbo claim (Idaho Springs district), and Santiago group (Argentine district), in addition to the output from the Phoenix mine (Trail district). Development work was done at the Red Elephant group, and some ore was shipped. Ore was shipped to custom plants from the Ameri-

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can Sisters dump, Eagle millsite, Franklin D., Golden Nest, Kaverne, Yankee, and other properties in the Montana district.

*Trail Creek district.*—Mining Associates, Inc., operated the Freeland group of mines continuously in 1938. The ore was concentrated by combined gravity and flotation in the mill at the mouth of the McClelland Tunnel near Dumont. The Phoenix Trail Mining Co. operated the Phoenix mine 182 days in 1938; the ore produced was concentrated in the Dumont mill. Lessees at the Lamartine group produced a substantial tonnage of gold-silver-lead ore, part of which was concentrated in local custom mills and part shipped direct to the Golden Cycle mill and the A. V. smelter. They also shipped a car of zinc-gold-lead-silver ore to the custom concentrator at Midvale, Utah. Ore from the Donaldson (Wheatland)-Little Champion, Lone Tree, Mendic, and Oneida-Stagg groups was shipped to the Golden Cycle mill and the Ruth mill.

### CONEJOS COUNTY

In 1938 Stunner Mines, Inc., built a mill at the Eurydice group at Stunner 43 miles southwest of Monte Vista and operated it 6 weeks on ore from the Eurydice dump. The equipment of the mill consists of a jaw crusher, 4- by 4-foot ball mill, jig, table, classifier, and four-cell flotation machine. The mine shaft was unwatered to a depth of 300 feet, and some of the drifts were cleaned out and retimbered.

### COSTILLA COUNTY

*Grayback district.*—A watchman at the property of the Drum Estate produced placer gold by sluicing gravel in Grayback Gulch during the summer of 1938. A little gold was recovered from the Griffith placer.

### CUSTER COUNTY

*Hardscrabble district (Westcliffe, Silver Cliff).*—Shore, Kettle, Henning, & Stroehlke operated their 10-ton cyanide plant at Silver Cliff a few months in 1938 on material trucked from a tailings dump on the Nemaha-William property. Gold-silver precipitates produced were shipped to the Midvale (Utah) refinery. Smelting ore was shipped from the Defender and Little Annie claims.

### DENVER COUNTY

A few of the individuals who tried sluicing on Platte River and Cherry Creek in Denver in 1938 recovered a little gold.

### DOLORES COUNTY

*Lone Cone district (Dunton).*—The Modern Gold Mines, Inc., continued development of the Emma mine for several months in 1938 and made a test run in the mill, using 165 tons of ore. The concentrates produced and a little crude ore were shipped to the Leadville smelter.

*Pioneer district (Rico).*—The output from the Pioneer district in 1938 comprised 220 tons of zinc-lead-silver ore shipped to custom flotation plants and smelters in Utah from the Pro Patria group, Nora Lilly claim, and Rico Townsite, all worked by lessees. The

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Rico Argentine Mining Co. carried on development work at its property and late in the year constructed a 150-ton selective flotation mill equipped to make three products—lead concentrates, zinc concentrates, and copper-iron concentrates; however, production was not begun in 1938. The mine was an important producer of zinc, lead, silver, and copper prior to 1931. The St. Louis Smelting & Refining Co. continued developing its property. A little placer gold was recovered by individuals sluicing on Dolores River.

### DOUGLAS COUNTY

Intermittent small-scale placer mining in 1938 on Cherry and Dry Creeks and Newlin and Russellville Gulches near Parker and Franktown resulted in the recovery of many small lots of gold dust that were sold to dealers in Denver.

### EAGLE COUNTY

*Burns and McCoy district.*—Placer gold was produced by sluicing on the Colorado River near Burns.

*Holy Cross district.*—The Hunky Dory claim was worked on a small scale from July 1 to November 1, 1938. Part of the ore produced was treated in a small stamp-amalgamation mill on the property, and part was shipped to other plants for testing.

*Red Cliff district (Battle Mountain).*—The Empire Zinc Co., subsidiary (changed July 1, 1938, to Division) of the New Jersey Zinc Co., operated its Eagle mine group at Gilman continuously in 1938. The mine has been an annual producer since the company began developing it in 1912. In 1929 a 600-ton underground flotation mill was built and placed in operation, and in 1930 the mine was the principal producer of silver, copper, and zinc in Colorado and an important producer of lead and gold. Mining of zinc-lead ore was suspended in 1931, and the mill was closed and has remained idle through 1938. From 1931 to 1938, inclusive, the mine has continued to be the State's largest producer of silver and copper and a substantial producer of gold from copper-iron-silver-gold sulfide ore shipped to smelters, mostly to the copper smelter at Garfield, Utah. This ore contains comparatively small quantities of lead and zinc; some of the lead is recovered, but none of the zinc is saved. The output from other mines in the Red Cliff district during the year comprised gold-silver-copper ore shipped to smelters from the Alpine, Ben Butler, Cora, Evening Star, Ground Hog, Star of the West, and Tip Top properties and a 2-ton lot of gold ore shipped to a smelter from a prospect.

### ELBERT COUNTY

Individuals sluicing at small placers near Elizabeth recovered placer gold in 1938.

### EL PASO COUNTY

#### GOLDEN CYCLE MILL

The Golden Cycle custom mill at Colorado Springs ranked fourth among producers of gold in the United States (including Alaska) in 1937. In 1938 it treated 524,177 tons of ore having an average gross value of $10.83 per ton, of which 480,105 tons were gold-[silver]-

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sulfotelluride ores from the Cripple Creek district, Teller County, and 44,072 tons comprised miscellaneous gold, gold-silver, and gold-silver-lead-copper ores from other districts, mainly in Boulder, Clear Creek, Gilpin, and Lake Counties. The mill, built in 1907 as a 1,200-ton roast-amalgamation-cyanidation plant, has been operated continuously ever since and has been enlarged to make use of the flotation- and gravity-concentration processes in handling low-grade Cripple Creek ores and miscellaneous ores containing base metals. In 1938, as usual, average-grade Cripple Creek ores comprised most of the mill feed. These ores, with which were mixed iron concentrates made from low-grade ores, were roasted, amalgamated,[1] and cyanided. Miscellaneous ores containing appreciable quantities of base metals were treated by selective flotation. The tailings from all operations were separated into sand and slime fractions and cyanided. The mill recovered 99 percent of its total gold output in the form of gold-silver bullion; the remaining 1 percent was contained in lead-copper concentrates shipped to the Leadville smelter. Equipment for firing the roasters with pulverized coal was installed in 1937. Improvements made in 1938 included the installation of a large crusher to replace a smaller one in the primary crushing plant and the placing of screens ahead of the jaw crusher and Symons cone crushers, which, with changes in the secondary crushing equipment, raised the capacity of these units and reduced the number of daily shifts necessary for the crushers to run. The more efficient crushing equipment furnished finer material to the ball mills in the concentration department and raised the capacity of this section from 450 to 550 tons daily. Economies effected by these improvements and those made in other departments of the mill during the past few years enabled the management to try to stimulate development work and prolong the productive life of the Cripple Creek district by a revision, effective December 1, of the mill schedule of gold payments and treatment and freight rates designed to increase the revenue to the shipper by approximately 40 cents per ton on ore having a gross value of $5 a ton and ranging up to $1.15 per ton on ore valued at $11.30 a ton.

### FREMONT COUNTY

A car of copper ore each was shipped from the Green Mountain and the Copper Gulch Mining Co. properties near Parkdale to the Garfield (Utah) smelter in 1938. A little placer gold was recovered by sluicing at the old Dorcas millsite at Florence.

### GARFIELD COUNTY

*Rifle Creek district.*—A lessee worked the Gray Eagle mine 8½ miles north of New Castle during the last 6 months of 1938 and shipped to smelters 103 tons of gold sulfide ore containing a little silver and copper. The development work done comprised a 60-foot winze, 50 feet of drifting, and 30 feet of raising.

### GILPIN COUNTY

*Southern districts (Blackhawk, Central City, Nevadaville, Russell Gulch).*—Production of metals in 1938 from lode mines in the southern

[1] Free gold saved on lightweight canton-flannel blankets and amalgamated in iron arrastre.

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districts of Gilpin County declined from 1937, owing to the shutdown after February of "The Patch" property and large Chain O'Mines mill at Central City and the idleness nearly all the year of the Bobtail Tunnel group and Gregory-Bates mill at Blackhawk, active throughout 1937. In 1938 the Gold Ridge Mining Co. did 1,000 feet of drifting at the Clay County group and erected a 75-ton flotation mill. The mill began treating ore in August and continued in operation to the end of the year. During the year the Gunnell, Corydon, Phoenix, Huddleston, and Buell claims in the consolidated group owned by the California-Hidden Treasure Mines Co. produced a total of 993 tons of ore, which yielded 215 ounces of gold and 740 ounces of silver. In addition, 13,000 cubic yards of placer gravel on the Buell claim, handled by a power shovel and screening and sluicing plant on skids, yielded 214 fine ounces of gold and 42 fine ounces of silver. A 15-ton stamp amalgamation-table concentration mill was run throughout the year at the New Brunswick mine. Colorado Silver Mines, Inc., ran its 100-ton flotation mill intermittently on ore from the Black Jack group. The Golden Gilpin custom mill at Blackhawk was operated for a few weeks, mostly on material obtained from dumps. The War Dance mill was reconditioned and was run about 30 days on ore from the Crown Point mine in Clear Creek County. The Big Four Mining & Milling Co. treated ore from the Kirk mine for a period after August in the remodeled Bolen mill. The mine was operated earlier in the year by Raoul Mines, Inc., which shipped ore to other custom plants. Small-scale mining carried on all or part of the year at the following mines and dumps resulted in the shipment of ore to custom mills, chiefly the Golden Cycle mill at Colorado Springs: Becky Sharpe, Columbus-Lotus, Druid, Federal, Frontenac, Golden Cloud, Golden Dollar, Iowa, Justice, Morning Star, Pewabic group, Robert Fulton, Snowden, Stewart, Wautauga dump, West Notoway, and others.

The Manion Placer Co. operated its dragline and land dredge on the Eugene placer on North Clear Creek below Blackhawk 186 days in 1938 and was the largest producer of gold in Gilpin County during the year. Placer ground on the Missions Mines Co. property in Russell Gulch was worked from March to December with a ½-cubic-yard dragline and sluices. Small sluicing operations were carried on by many individuals in the vicinity of Blackhawk and Central City and on North Clear Creek below Blackhawk.

*Northern districts.*—The Dirigo Mining Co. operated the Dirigo mine and amalgamation-flotation mill through most of 1938. The Tip Top Mines, Inc., worked the Perigo group under lease part of the year and treated some ore in the mill at the mine. Ore was shipped to the Golden Cycle mill from the Lone Star, Martha, Mitchell, Newport, Semiprone, and other properties. The Gilpin County Gold Mining Corporation ceased production early in the year at the We Got Em and Cowboy group at the head of Silver Creek. The Cooley Gravel Co. worked the Pactolus placer near Pinecliff with a rated 2,000- to 2,500-cubic-yard floating dredge fed by a 1½-cubic-yard dragline for its second season, which lasted from April 10 to December 13. The yield from 419,958 cubic yards of gravel handled was 3,166 fine ounces of gold and 279 fine ounces of silver. F. R. Wolfe operated a dragline excavator and special land sluicing plant in Lump Gulch from April 15 to June 20 and recovered 63 fine ounces of gold. Small sluicing operations in Gamble and Lump Gulches yielded some gold.

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### GRAND COUNTY

Prospectors sluicing on Bronco Creek and Colorado River recovered a little gold in 1938.

### GUNNISON COUNTY

*Box Canyon district.*—A lessee at the Independent mine, 6 miles south of Pitkin, erected a mill consisting of a crusher, four rapid-drop stamps, amalgamation plates, and launders in which he treated 225 tons of ore in 1938 and recovered 19.60 fine ounces of gold and 3 fine ounces of silver.

*Elk Mountain district.*—Some development work was done and a 10-ton gravity-concentration mill installed in 1938 at the Baxter property. The only metal produced was contained in 1.3 tons of gold-silver-lead concentrates made from 25 tons of ore run through the mill for testing. A car of smelting ore was shipped from another property in the Elk Mountain district, and a little gold was recovered from a placer in Washington Gulch.

*Gold Brick district.*—The Carter Mines Co. continued production in 1938 from the Carter mine and mill on Gold Creek. The mine is opened by an 8,800-foot adit, a 1,200-foot, vertical, four-compartment raise, and numerous drifts. Water from Gold Creek furnishes power to run the mill, which has a capacity of 125 tons daily and treats the ore by amalgamation and gravity concentration. The Old Tom Mining Co. treated 150 tons of ore from the Cortland group in the leased Roosevelt mill near Pitkin early in 1938 and also shipped some ore to smelters. Operations were discontinued after April 15 and the company gave up its lease on the mine. A car of gold-silver-lead ore was shipped to the Leadville smelter from the Bertha mine. A little gold was recovered by amalgamation at the Idoline, Wayne, and one other property in the Gold Brick district.

*Quartz Creek district.*—Lessees at the Fairview group shipped 46 tons of silver-lead-gold ore to the Leadville smelter in 1938.

*Spring Gulch district.*—A lessee at the Doctor group shipped 93 tons of zinc carbonate ore early in 1938 to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans.

*Taylor Park (Tin Cup) district.*—Ore treated in a small mill at the Red Buck-Trail Horse group of lode claims yielded a few ounces of gold in 1938. Individuals sluicing on Willow Creek and other streams in Taylor Park recovered small quantities of placer gold.

### HINSDALE COUNTY

*Galena district.*—The M. B. Burke Investment Co. operated its flotation mill in 1938 at the Ute and Ulay group on Henson Creek from June 15 through November. Material containing zinc, lead, gold, silver, and copper was shipped from the Mill Placer to the custom concentrator at Midvale, Utah. Twelve tons of silver-lead ore from a stope in the California mine were trucked to the Leadville smelter.

*Lake district.*—In 1938 the Ramsey Brothers Gold Mining & Milling Co. treated 100 tons of silver-lead-gold-copper ore from the Gladiator mine by gravity concentration; the yield was 12 tons of concentrates, sold to the Leadville smelter.

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### JACKSON COUNTY

A placer miner recovered a little gold on Independence Mountain northwest of Walden in 1938.

### JEFFERSON COUNTY

Individuals continued small-scale intermittent sluicing operations along Clear Creek in 1938 and produced many small lots of placer gold, which were sold to refiners, assayers, and the mint in Denver.

### LAKE COUNTY

#### LEADVILLE DISTRICT

Leadville continued to be the center of the smelting industry of Colorado in 1938. The American Smelting & Refining Co. operated its Arkansas Valley lead bullion-leady copper matte smelter continuously (one furnace) on ores and concentrates purchased from operators in virtually all the active mining districts of the State; receipts from Colorado totaled 107,335 tons compared with 122,235 tons in 1937. In 1938 small lots of ore from New Mexico and Wyoming and 82 tons of combined ore and concentrates from South Dakota were received.

Compared with 1937 the output of ore from lode mines and dumps in the Leadville district in 1938 decreased 74 percent, and the total value of the recovered gold, silver, copper, lead, and zinc decreased 55 percent. The 400-ton Leadville Metals mill, which in 1937 treated 124,457 tons of low-grade dump material containing chiefly gold but also some recoverable silver, copper, and lead, was closed February 2, 1938, and remained idle throughout the rest of the year. However, new mills placed in operation in 1938 by the London Deep Mines Co. at the First National shaft and the H. G. N. Mining & Milling Co. on the Henriett claim treated a total of 10,800 tons of material from dumps in the district. Low-grade ore was shipped from the Ballard, Breece, "Lilian", and President dumps to the Golden Cycle mill at Colorado Springs. Most of the output of newly mined ore and that sorted from dumps was sold direct to the A. V. smelter, but some was shipped to the Golden Cycle mill. No zinc-lead ore was shipped from the district to the pigment plant at Coffeyville, Kans., in 1938, and there was a large decrease from 1937 in the quantity of zinc-lead-gold-silver-copper ore shipped to the custom concentrator of the United States Smelting, Refining & Mining Co. at Midvale, Utah; the only important producer of this type of ore in 1938 was the Fortune mine. Lessees continued production of gold ore from the Ibex group. Some of the other producing mines and dumps in 1938 follow: Chippewa, Commerce, Dolly B, Eliza dump, El Paso dump, Fanny Rawlings, Highland Chief and Highland Mary, Iron Hat, Lilian (mine), Matchless, New Monarch, Ollie Reed, Little Ellen, St. Louis, Morning Star dump, Resurrection, Sunday dump, Tenderfoot, Tribune, Triumph, and Venir. Individuals sluicing in California Gulch recovered placer gold.

*Granite district.*—The output from the Lake County part of the Granite district in 1938 comprised gold, silver, and lead contained in ore and a small quantity of bullion shipped from the Belle of Granite mine and placer gold produced by individuals sluicing mostly on Arkansas River.

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*Lackawanna Gulch district.*—The Eureka Saturday Night Mining Co. drove 400 feet of tunnel and raises at the Eureka-Saturday Night group in 1938 and erected a 50-ton jig- and flotation-concentration mill which was run during the latter half of the year. Some ore from the Mt. Champion group was treated in a mill installed on the property in 1938.

*St. Kevin-Sugar Loaf district.*—Edward P. Chapman shipped 111 tons of gold-silver ore to the Leadville smelter from the Amity mine, operated from June to December 1938. Several hundred tons of siliceous silver ore from the St. Kevin dump were hauled to the First National mill near Leadville and treated by flotation.

*Tenmile (Climax, Fremont Pass) district.*—The Climax Molybdenum Co. at Climax, 13 miles north of Leadville, operated its flotation mill at a daily average of 12,000 tons for 362 days in 1938 and produced concentrates containing 28,242,085 pounds of elemental molybdenum, the largest annual output in the history of the mine.

*Tennessee Pass district.*—A dragline-dry land dredge installed in the summer of 1938 on the Columbia placer in Tennessee Gulch about 5 miles north of Leadville was operated from July 1 to September 1 and handled 150,000 cubic yards of gravel yielding 563.02 ounces of retorts and grains, which after being melted at the Denver Mint weighed 470.95 ounces and averaged 0.888 fine in gold and 0.088 fine in silver.

*Twin Lakes district.*—Small lots of smelting ore were shipped from the Gordon-Tiger and Columbine lode claims in 1938. The dragline-dry land dredge on the Derry Ranch placers was operated from May to November.

### LA PLATA COUNTY

The American Smelting & Refining Co. lead bullion-leady copper matte smelter at Durango, which was closed November 30, 1930, remained idle in 1938.

*Animas River district.*—Testing of placer ground on Animas River north of Durango resulted in the recovery of a few ounces of gold in 1938.

*California (or La Plata) district (Hesperus, La Plata).*—Pioneer Gold Producers, Inc., operated the Idaho mine and mill from January 1 to April 8, 1938, after which both were idle to the end of the year. The property was sold to Consolidated Gold Producers, Inc., as of July 1, 1938, and the former operating company was dissolved. Lessees did some work at the May Day mine, equipped with a 50-ton flotation mill, and shipped small tonnages of crude ore to the Golden Cycle mill and concentrates to the Leadville smelter. A little ore was shipped from the Hazel M claim, Old Story, Tomahawk, and an unidentified claim. The Amparo Mining Co. ceased development work at the May Rose group.

### LARIMER COUNTY

Small lots of sorted high-grade gold ore were shipped in 1938 from the Little Mary Mason mine in the Masonville district to the Golden Cycle mill.

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### MINERAL COUNTY

*Creede district.*—The local market for ore furnished throughout 1938 by the custom flotation mill of Creede Mills, Inc. (inadvertently called Creede Mines, Inc., in Minerals Yearbook, 1938, p. 271), stimulated production in the Creede district and resulted in an increase of 42 percent over 1937 in the district output of silver. In 1938 the company treated 35,179 tons of ore, of which about 70 percent was newly mined and 30 percent came from dumps. The heads into the mill averaged 0.006 ounce of gold and 18.2 ounces of silver to the ton and 1.35 percent lead. The ratio of concentration was 38 tons into 1, and the concentrates averaged 0.20 ounce of gold and 471 ounces of silver to the ton and 13.6 percent lead; they were shipped to the Leadville smelter. The following properties supplied the ore treated in 1938: Alpha-Corsair, Amethyst, Commodore-Bachelor, and New York-Last Chance-Del Monte-Pittsburg groups and Manitoba and Monon mines. Lessees working the Ochre mine shipped ore direct to the Leadville smelter.

### MOFFAT COUNTY

*Fourmile (or Timberlake) district.*—Eldorado Gold Placer Mines continued production in 1938 from its placer ground about 29 miles north of Craig, worked with a gasoline-powered dragline excavator and dry-land dredge. The season's operations lasted from May 14 to October 12. Sluicing at the Old Faithful, Sage Hen, and other placers in the Fourmile district recovered some gold.

### MONTEZUMA COUNTY

The Red Arrow Gold Corporation worked the Red Arrow mine in the East Mancos River area continuously in 1938. Production totaled 638 tons of ore yielding 1,744.08 fine ounces of gold, 3,447 fine ounces of silver, and 2,500 pounds of recoverable copper. The richest ore was crushed and amalgamated in a small mill at the mine, and the rest was shipped to smelters. The company did 1,000 feet of development work in the mine during the year. The Barr-Menefee Mining Co. drove 100 feet of tunnel at the Stafford group and shipped 21 tons of gold-silver-copper-lead ore to the Midvale (Utah) smelter. Gold-silver-copper ore was shipped from the Omaha Placers property, adjoining the Red Arrow group. A little gold was recovered from a placer claim on East Mancos River.

### MONTROSE COUNTY

*La Sal district.*—Lessees at the Cashin and Sunrise claims shipped 119 tons of copper-silver ore to the Garfield (Utah) smelter in 1938. Placer miners, with pumps and sluices, continued to recover placer gold on Dolores River.

*Naturita district.*—Small sluicing operations on San Miguel River recovered placer gold in 1938.

*Paradox Valley district.*—The United States Vanadium Corporation operated its vanadium mines and roasting and leaching plant at Uravan continuously in 1938, producing at the rate of 240 tons of ore daily and drawing at will the grade of ore desired. Production of the finished product was greater than in 1937. The company extracts its own salt in the vicinity and owns and operates its own coal mines.

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### OURAY COUNTY

*Red Mountain district.*—San Juan Metals, Inc., operated the Treasury Tunnel group from January to October 1938, but production was interrupted for a few weeks in April when the blacksmith shop and some other buildings burned and had to be rebuilt. The ore was treated in the company 300-ton selective flotation mill. The product of the mill was copper concentrates and lead-copper concentrates, both of which contained gold and silver and some zinc. Although production ceased in October the company planned to continue the drift on the Handicap vein about 300 feet farther and then crosscut to the Barstow vein. Ore produced at the Meldrum-Hoffman group, under development by G. A. Franz, was treated in the G. A. Franz flotation mill 2 miles north of Ouray.

*Ridgway district.*—Small placer operations on Uncompahgre River near Ridgway produced placer gold in 1938.

*Sneffels district.*—King Lease, Inc., made an increased output over 1937 of gold-silver bullion and gold-silver-lead-copper concentrates from its amalgamation-flotation mill, run continuously in 1938 on ore from the Camp Bird mine. The capacity of the mill is 75 to 100 tons daily. The company extended its development and mining below the third level and started development (specified upon renewal of its lease) in the west heading of the lower adit level 1,450 feet below the third level. Sublessees at the Humboldt group near the line between San Miguel and Ouray Counties shipped a car of silver-gold-lead ore sorted from the dump to the Garfield (Utah) smelter. A little gold was recovered from 10 pounds of ore from the Alma claim reduced and amalgamated by hand.

*Uncompahgre district.*—A lessee on the property of the Bachelor Development Co. shipped several hundred tons of silver-lead ore to smelters in 1938. G. A. Franz treated ore from the Wedge and Bachelor dumps in his flotation mill from March 15 to May 25. A lessee at the Pony Express-Upper Bachelor group shipped silver-lead ore to the Leadville smelter. The McCullough Lease shipped gold-silver-copper ore to the Leadville smelter from the American Nettie, O & N, and Wanakah groups, worked as a unit, and treated 1,000 tons of old tailings from the Wanakah mill dump in a flotation mill on the property. Smelting ore was shipped from other properties in the Uncompahgre district under development in 1938, including the Mineral Farm, Ophir, and Senorita Extension groups.

### PARK COUNTY

*Alma Placers district.*—Lessees continued sluicing, drift mining, and power shovel operations on leased blocks of the Alma placers in 1938. Among the important producers were the Alplaco Mining Co., Logue, R & W, and Richards leases.

*Beaver Creek district.*—The Timberline Dredging Co. set up a connected-bucket electric-powered floating dredge with a capacity of 5,000 cubic yards daily on ground of the Placers Realty Co. on Beaver Creek 1½ miles north of Fairplay and began production October 25, 1938. The bucket line has 88 buckets, each with a capacity of 7½ cubic feet. Most of the machinery was obtained from the dismantled Continental dredge formerly in Summit County. The dredge was operated intermittently to December 16 and handled about 115,000

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cubic yards of gravel, which yielded placer gold weighing 465.53 ounces after being melted at the Denver Mint and averaging 0.795 fine in gold and 0.175 fine in silver. Individuals recovered placer gold by sluicing and hydraulicking at the Shelton and other placers on upper Beaver Creek during the summer months.

*Buckskin district.*—Most of the metal output of the Buckskin district in 1938 was contained in gold-silver-lead ore shipped to the Leadville smelter by lessees at the Union No. 5 mine. The other producers were the Excelsior and Silver Wave groups, both equipped with small concentration mills; Phillips, under development throughout the year; and another property producing less than a ton of ore. A little gold was recovered from placers in Buckskin Gulch.

*Consolidated Montgomery district.*—Alma Syndicate, Inc., operated its cyanide mill on the Tolstoi claim on Mount Bross at an average daily rate of 52½ tons for 110 days in 1938 on gold-silver ore mined with a power shovel from open-cuts on the Morning Star group. The mine was operated from July 19 to November 19; 200 feet of development work were done underground, and 15,000 tons of surface material were stripped. Starting in October 1938 the Magnolia Gold Mining Co. remodeled the mill at the Magnolia mine and late in the year treated 150 tons of gold ore by flotation and gravity concentration. Some placering was done in Montgomery Gulch during the year.

*Fairplay district.*—Individuals continued to recover placer gold in 1938 by sluicing along Platte River west and south of Fairplay.

*Horseshoe district.*—The Cole Colorado Co. shipped 11 tons of silver-lead ore from the Peerless group to the Leadville smelter in 1938.

*Mosquito district.*—The output of gold from the Mosquito district in 1938 decreased 10,919 ounces (25 percent) from 1937. The London Mines & Milling Co., which ranked first among gold producers in the district and fourth in the State in both years, operated the consolidated London, London Extension, and "North London" groups through the 4,400-foot London Extension tunnel continuously in 1938. The ore was treated in the company 200-ton mill by combined gravity and flotation concentration. Besides gold, the flotation concentrates shipped contained some silver, a little copper, and substantial quantities of lead and zinc; the zinc was not saved at the Leadville smelter, to which the concentrates were sold. The London-Butte Gold Mines Co., the second-largest operator in the district, continued production from the Butte mine and 100-ton flotation mill. The mine workings are reached through a vertical shaft 512 feet deep. Development work done in 1938 totaled 2,763 feet. The yield from 20,737 tons of ore treated was 1,940 tons of concentrates averaging 2.96 ounces of gold and 1.67 ounces of silver to the ton, 4.50 percent lead (wet assay), and 2.22 percent zinc. W. A. Ellis, Inc., shipped high-grade gold ore from the American mine to the Leadville smelter. The Chicago Mines Co. treated 24,793 tons of ore from the South London dump in the Record mill. The concentrates produced averaged 3.35 ounces of gold to the ton and contained some recoverable silver and lead. Concentrates caught in launders and amalgamated in a barrel yielded 688 fine ounces of gold. Among other producers in the district in 1938, operated part of the year, were the Hock Hocking, Nova Zembla, Orphan Boy, and Susquehanna. Prospecting and testing were done at the Pennsylvania Mountain placer, which has yielded

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some gold annually from intermittent small-scale operations during the past few years.

*Tarryall district.*—The Peerless Mining Co. operated its gasoline-powered 1¼-cubic yard shovel and portable Ainlay four-bowl washing machine for the fifth consecutive season on the Wilson placer 7 miles southeast of Como. In 1938 the plant was run from April 27 to November 3 and handled 79,135 cubic yards of gravel. Individuals sluicing on Tarryall Creek recovered small lots of placer gold. Examination including rechecking of extensive pits and churn-drill holes on the Fortune Placer, Peabody Placer, and Cline Ranch old river channels was done in 1938. Additional gold-bearing yardage was developed and adjacent property purchased.

### PITKIN COUNTY

*Lincoln Gulch district.*—A small lot of gold-silver ore was shipped to the Leadville smelter from the Three Brothers claim in 1938.

*Roaring Fork district (Aspen).*—Shipments of silver ore containing lead and lime to the Leadville smelter were continued in 1938 from the Smuggler and Spar Consolidated properties, both under the management of D. P. Rohlfing. The Midnight Mining Co. treated 5,000 tons of siliceous silver ore from the Midnight group in the company 50-ton flotation mill. The products of the mill were 238 tons of lead concentrates, averaging 256 ounces of silver to the ton and 54.6 percent lead (wet assay), shipped to the Leadville smelter; and 201 tons of byproduct zinc concentrates, averaging 20.5 ounces of silver to the ton, 1.5 percent lead (wet assay), and 47 percent zinc, shipped to the Amarillo (Tex.) zinc smelter. During the year the company sank a 50-foot winze and drifted 50 feet to cut the ore body below the level of the main 6,700-foot adit. The Metals Recovery Co. operated the Hunter Creek mill for a period in 1938 on dump material, mostly from the Franklyn mine dump. A car of smelting ore was shipped from the Hope mine.

### RIO GRANDE COUNTY

Summitville Consolidated Mines, Inc., operated its group of mines and mill at Summitville continuously in 1938. The mining and milling methods and costs at this property as of August 1937 have been described by Guiteras.[2] Extensive development of the property since 1934 has resulted in a steady annual increase in production, and in 1938 the company ranked fifth in the State in gold output. During the year the company discontinued use of the flotation machines and tables, installed a jig in the ball-mill circuit to remove a high-grade sulfide concentrate for shipment direct to the smelter, and then treated the remainder of the pulp by the all-slime cyanide process. The precipitates are smelted at the mine and the bullion produced is shipped to the Denver Mint. Lessees at the Guadalupe property at Jasper shipped a 15-ton lot of gold-silver ore to the Leadville smelter in 1938.

[2] Guiteras, Jos. R., Mining and Milling Methods and Costs at the Summitville Consolidated Mines, Inc., Summitville, Colo.: Bureau of Mines Inf. Circ. 6990, 1938, 23 pp.

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### ROUTT COUNTY

*Hahns Peak district.*—The Hornet Gold Mining Co., working placer ground in Ways Gulch with a dragline-dry land dredge from May to September 1938, handled 21,000 cubic yards of gravel. Individuals produced a little gold by sluicing in the same area. No production was made from lode mines in the Hahns Peak district in 1938.

### SAGUACHE COUNTY

*Blake district.*—Development work in 1938 at the Copper Head claim resulted in the shipment of 4 tons of gold-copper ore to the International smelter at Tooele, Utah. The Cotton Creek Mining Co. shipped a test lot of copper-silver ore to the Garfield (Utah) smelter.

*Crestone district.*—Ore from the Eastern Star mine, one of the claims in the group in the mineral section of Baca Grant No. 4 under lease to the Luis Maria Baca Mining & Development Co., was treated by amalgamation and flotation in the company mill on Cottonwood Creek. A lessee at the Sunbeam claim recovered 15¾ pennyweight of amalgam 0.700 fine in gold from 3 tons of ore taken from an open-cut and treated in a 2-ton Gibson mill.

*Kerber Creek district (Bonanza).*—The Rawley mine, operated under lease throughout 1938 by Rawley Mines, a limited partnership, produced 6,764 tons of silver-copper-lead-gold ore, most of which was shipped to the copper smelter at Garfield, Utah; part of the remainder was concentrated in a custom mill at Bonanza, and part was shipped to the Leadville smelter. The W. C. H. Milling Co. treated 1,000 tons of ore from mines in the Kerber Creek district in a flotation mill built near Bonanza in 1938. Some ore was shipped direct to the Leadville smelter from the Klondyke, Rosalee, Sunnyside, and Warwick mines.

### SAN JUAN COUNTY

*Animas district.*—Operations of the Shenandoah-Dives Mining Co., a large, steady producer since 1928, were interrupted for 7 weeks in March and April 1938 by damage to the aerial tram connecting the mine and mill caused by a snowslide, but the expanded rate of ore production made possible through development work in the mine and an increase in the capacity of the mill enabled the company to handle more ore than in 1937 or any previous year, despite the interruption. Equipment added to the mill in 1938 included one eight-cell and one six-cell flotation machine and a thickener and conditioner. The daily capacity of the mill was 750 tons at the end of the year. The company ore treated totaled 211,293 tons and yielded 7,120 tons of concentrates containing 18,993 ounces of gold, 329,197 ounces of silver, 1,566,749 pounds of lead (wet assay), 1,556,980 pounds of copper (wet assay), and 1,025,647 pounds of zinc. During the first 10 months of 1938 the company made bulk lead concentrates and some zinc concentrates; during the remainder of the year it made four products—lead flotation concentrates, copper flotation concentrates, zinc flotation concentrates, and iron table concentrates. In addition to its own ore the company treated 7,072 tons of custom ore from other mines in San Juan County, comprising,

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in approximate order of tonnage supplied, the Champion, Old Green Mountain, Ridgeway dump, Mystery, North Star-Sultan, Ezra R, Silver Ledge, Coming Wonder, Little Fannie, Bandora, Robert Bonner, and Snowslide. Some of the operators that shipped ore to the Shenandoah-Dives mill also shipped ore of smelting grade direct to the Leadville smelter. A few cars of ore were shipped to smelters from other mines in the district, including the Mexican group, Peerless, and St. Paul. A lessee at the Mable mine in the Copper Bell group treated 190 tons of gold-silver ore by amalgamation in a 10-ton mill at the mine. A 15-ton pilot mill erected at the Kankakee group was operated for a few weeks to test the ore. The American Smelting & Refining Co. continued development of the Silver Lake group through the 3,000-foot crosscut from the main haulage adit of the Mayflower group. Sluicing at the Depression placer claim 6 miles northwest of Silverton and at another placer in Red Canyon produced several ounces of placer gold.

*Eureka district.*—The Sunnyside Mining & Milling Co., which reopened the Sunnyside mine in 1937 and began production September 1, continued operations to June 30, 1938, when the mine was closed and remained idle to the end of the year; it was, however, the largest producer of lead and zinc in the State in 1938 and an important producer of gold, silver, and copper. The ore was transported from the mine over a 3½-mile aerial tram to the company 1,000-ton selective flotation mill at Eureka for treatment. The products of the mill were zinc concentrates (carrying also lead, copper, silver, and gold) shipped to the zinc smelter at Amarillo, Tex., and lead concentrates and iron concentrates (both carrying gold, silver, copper, and zinc) shipped to the Leadville smelter. In the latter part of the year the company did some work on a proposed 16,000-foot development and transportation adit to reach from the mine workings to the mill but suspended all activity at the property early in 1939. High-grade gold-silver-lead ore was shipped from the Brooklyn group to the Leadville smelter. Lessees at the Robert Bonner group shipped 38 tons of ore to the Shenandoah-Dives mill. Development work was continued at the Sandiago-Golden Fleece-Scotia group.

*Ice Lake Basin district.*—The Blanco Mining Co. drove 148 feet of drifts at the Bandora group from June 24 to November 5, 1938, and shipped 36 tons of ore to the Shenandoah-Dives mill and 137 tons to the Leadville smelter.

### SAN MIGUEL COUNTY

*Iron Springs district (Ophir).*—The Butterfly Consolidated Mines, Inc., operated its group of mines and 100-ton gravity- and flotation-concentration mill continuously in 1938. The mill treated 16,000 tons of ore which yielded 2,002 tons of combined table and flotation concentrates containing 1,066 ounces of gold, 139,783 ounces of silver, 339,764 pounds of lead (wet assay), 74,854 pounds of copper (wet assay), 40,853 pounds of zinc, and 1,075,812 pounds of iron. The concentrates were shipped to the Midvale (Utah) smelter. The company drove 1,000 feet of development drifts and tunnels during the year and discovered a new body of silver-lead ore in a heretofore undeveloped vein. Several cars of smelting ore were shipped from the Carbonero and Hattie mines. Lessees treated approximately

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50 tons of old tailings from the Suffolk millsite in a small amalgamation-gravity concentration mill erected to test the material. A little ore was shipped from other properties in the Iron Springs district, and some gold was recovered by amalgamation at the Gold Bar lode group and by placer methods at the Waterfall placer.

*Lower San Miguel district* (*Sawpit, Vanadium*).—Placer miners sluicing along San Miguel River and its tributaries produced some gold in 1938.

*Mount Wilson district.*—Individuals working the Special Session, Polar, Lakeview, and Silver Pick groups during the summer of 1938 shipped small lots of high-grade gold ore to smelters.

*Upper San Miguel district.*—Veta Mines, Inc., maintained production from the Smuggler Union mine at a higher rate in 1938 than in 1937 and continued to be the largest producer in San Miguel County. Part of the ore produced in 1938 came from above the Pennsylvania Tunnel or fifteenth level, the former lowest workings, and part from the new 1,600-foot level. Additional productive ground was opened as the company carried exploration to greater depth, reaching the Telluride Conglomerate formation at the 1,700-foot level. The company made many surface improvements to effect economies in the handling and treatment of ore, including the construction of a new aerial tram rerouting ore transportation and the transfer of milling facilities to the large steel and concrete building adjoining the old plant. The yield from 68,777 tons of ore treated by amalgamation and flotation concentration and 109 tons shipped crude to smelters was 12,788 ounces of gold, 227,684 ounces of silver, and 1,552,003 pounds of lead (gross in concentrates and smelting ore). Alta Mines, Inc., continued developing the Alta-St. Louis group and mined and treated a daily average of approximately 100 tons of ore throughout the year, except during short interruptions necessary for repairing or altering equipment. A lessee treated tailings on the Gold Run dump by gravity concentration for 80 days in 1938 and shipped gold-silver-lead-copper concentrates to the Leadville smelter. Lessees at the Tomboy group cleaned out and retimbered some of the caved workings on the Montana claim. They shipped a car of smelting ore and 21 tons of concentrates produced with jigs and tables from 1,000 tons of ore cleaned up on the surface. The equipment was dismantled later. A lessee worked 2 months on the Juan millsite in Telluride, treating old tailings with a screen and table. Some ore was treated by amalgamation at the Laura, Savage, and other claims operated on a small scale. Individuals sluicing along San Miguel River recovered small quantities of placer gold. The American Smelting & Refining Co. did 623 feet of drifting at the Fairview group after May 1 under an option agreement that was relinquished December 12.

### SUMMIT COUNTY

*Breckenridge district.*—The output from lode mines in the Breckenridge district in 1938 comprised chiefly gold and gold-silver-lead ores shipped crude to the Leadville smelter from the Bemrose-Bostwick (also produces placer gold), Blue Flag, Fredonia, and Jumbo properties and zinc-lead-gold-silver ore shipped from the Royal Tiger property to the custom concentrator at Midvale, Utah. The Continental Dredging Co. operated its floating connected-bucket dredge on Blue

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River, which has been the chief producer of gold in Summit County since 1932, from January 1 to April 13, 1938, when the company ceased operations. The dredge (equipped with 88 buckets, each of 7½ cubic feet capacity) was then dismantled, and the machinery was moved to Beaver Creek in Park County where it was used by the Timberline Dredging Co. in the construction of another dredge. The Bemrose-Bostwick and Louis D placers, each worked with a steam shovel and specially constructed sluice, were among the other principal producers of placer gold in the district. The Beaverhead, High Bar, John Jay, Pittsburg, and many other placers on Blue River, Farncomb Hill, and French Gulch were worked with sluices and hydraulic giants by individuals.

*Montezuma district.*—The Florado Mining Co., operating from March to July 1938, drove 300 feet of development crosscuts, drifts, and raises at the Florado-Sts. John group and erected a 100-ton flotation mill. During the period the company treated 2,100 tons (wet weight) of silver-lead ore; the concentrates were shipped to the Leadville smelter. Zinc-lead-silver ore from the Wauneita claim was shipped to the custom concentrator at Midvale, Utah. The ore produced at other mines in the Montezuma district in 1938 was shipped to the Leadville smelter. Producing mines included the Bullion group, Hall, New York, Ruby Silver, and Silver King claims.

*Ten Mile (Kokomo, Robinson) district.*—The Gold Crest Mining Co. shipped 80 tons of sorted gold-silver ore from the Gold Crest mine, operated 175 days in 1938, to the Leadville smelter. Lead-silver ore sold to the smelter from another property, a small lot of silver-gold ore shipped by lessees at the Washington group, and a small lot of placer gold recovered at the Lucky Penny placer comprised the remainder of the output from the Ten Mile district during the year.

*Wilkinson district.*—Walter McDaniel worked his Big Four claim (opened July 23, 1937, on Green Mountain) during part of 1938 and shipped 196 tons of silver-lead-gold-[zinc] ore to the Leadville smelter. A few truckloads of gold-silver-lead ore were shipped to smelters from the King Solomon and Fish Tunnel groups.

## TELLER COUNTY

### CRIPPLE CREEK DISTRICT

The Cripple Creek district produced, in terms of recovered metal, 145,215 fine ounces of gold in 1938 compared with 145,071 ounces in 1937. The bulk of the gold was recovered in the form of bullion at the Golden Cycle mill at Colorado Springs, El Paso County. As the mill also treats ores from other Colorado mining districts, its operations are reviewed under El Paso County. Cripple Creek ores shipped to the mill in 1938 totaled 480,105 tons and comprised all the district output except that from the Iron Clad group treated by cyanide leaching at the mine and part of the production from the Cameron group treated in a new flotation mill on the property. The ore shipped generally contains gold as the only commercial metal, but some silver ore has been shipped from two or three veins in the district; a comparatively small quantity of silver is recovered annually in bullion produced from the gold ores.

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MINES REVIEW

The three largest producers of gold in the Cripple Creek district and in the State in 1938 were the United Gold Mines Co., an operating and holding company for property scattered throughout the district; the Cresson Consolidated Gold Mining & Milling Co., operating the Cresson, Dante, and Gold Sovereign mines; and the Golden Cycle-Ajax operations, working the Ajax-Granite group.

The annual report of the United Gold Mines Co. for the year ended December 31, 1938 (dated February 15, 1939), includes a report of the mine superintendent, which gives the following details on operations at individual mines:

*Bonanza.*—On the 22d level a low-grade body has been opened up on the X-10-U-8 vein. The grab samples run between 0.20-0.25 ounce. No stoping has been done on this to date. 270 feet of development work have been done on the 22d level.

On the 23d level the X-10-U-8 vein has been drifted on for 150 feet with no values encountered.

*Deadwood.*—The Gold Bullion Mines, Inc., lessees on the Deadwood, have produced a large tonnage of much better than average grade ore during the year and have also accomplished about 800 feet of development work on the first, second, and third levels. At the present time they are working three different ore shoots. One ore shoot on Trachyte ground has recently produced a carload of screenings which settled at 4.38 ounces. Prospects for this property during the coming year are very bright.

*Findlay-Shurtloff.*—The Golden Conqueror Mines, Inc., lessees on this property, has been very active during the past year, having accomplished 1,480 feet of drifting, 190 feet of raising, and 8 feet of winzing. They have also cleaned 80 feet of drifts on the 1,000 level of the Shurtloff and repaired 990 feet in the Manway side of the Shurtloff shaft. During the first 11 months of the year they have produced 10,423 tons of ore with a gross value of $107,488.67, and an average value of $10.31 per ton.

*Hull City.*—Operations on the Hull City were recently started by the United Gold Mines Co., and three sets of lessees operating on the split-check system have all discovered some ore, and we feel very hopeful that the mine will soon be on a paying basis.

*Isabella.*—This entire property has been leased to Hoy & Todd and associates and is the objective of a tunnel recently started on the 20th level of the Vindicator shaft. This tunnel will be 4,700 feet long; of this distance, approximately 1,300 feet has already been driven, but at the present time work on the tunnel has been suspended due to reorganization of the company. They expect to resume operations about January 10, 1939. A number of sets of sublessees are working on the surface and are producing some ore.

*Mountain Beauty.*—This entire property is leased to the Orpha May Leasing Co., and is being worked from the 13th level of the Orpha May shaft. They are driving a drift into Mountain Beauty ground and have discovered a small ore shoot and have shipped a few carloads of medium-grade ore.

*Patti Rosa-Hardwood-Little Joe.*—This entire property consists of about 15 acres and during the past year has been operated by the Tennessee Mines, Inc. This company has accomplished 1,193 feet of drifting and 450 feet of raising. It has mined 83,683 cubic feet of ore from the stopes and has shipped 91 railroad cars from the Hardwood, 6 cars from the Patti Rosa, and 9 cars from the Little Joe. This has all been medium-grade ore.

*Portland.*—The Portland Group has made a moderate but steady production through 1938, and the prospect for a continuation at the same rate in 1939 is good.

Portland No. 1, Portland No. 2, and the Last Dollar shafts have been operated by the company, with an average of 10 sets of lessees at No. 1, 6 sets of lessees at No. 2, and 10 sets of lessees at the Last Dollar.

No work has been done by the company underground except necessary repair work. All other mining has been done by lessees. A considerable amount of development was accomplished by lessees, some of it with assistance from the company. A fair amount of ore was developed by this work, and this has enabled the mine to maintain production.

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The more notable discoveries include the ore shoot on the Bobtail vein, above 1,600 level, Portland No. 1; a new ore shoot on the Wisconsin vein, 1,300 Last Dollar, and the uncovering of some new ore bodies adjoining old stopes on the Wisconsin and 1,218 veins of the Last Dollar.

In addition to the company operated shafts, various other portions of the Portland Group have been operated by lessees on a royalty basis. Among these are the Independence, Colorado City, Portland No. 3, and several shallow shafts on Battle Mountain. These have contributed substantially to the total production.

The water in Portland No. 2 workings is receding very slowly, because of drainage from Ajax or Cresson pumping, and eventually another level (2,400) may be accessible.

*Rose Nicol-Trail-Last Effort.*—The Rose Nicol has produced a good grade of ore during the past year. Most of the company production has come from 900 and 1,000 through the Rose Nicol shaft, and from 1,700 of the Cresson. Production from 1,400 Cresson was stopped July 1.

A large low-grade deposit has been developed below 1,000 from the Berger winze, and at the present we are cutting out in the winze so that we will be able to start drifting on the Trail vein towards the shaft. Also a cross-cut is being driven from 1,700 of the Cresson to cut the Trail vein at greater depth.

On July 1 the mine was opened to lessees from 1,000 to surface, with the exception of a few blocks withheld by the company. The lessees have been heavy producers, with most of the ore coming from the 300 and 1,000 levels.

*Theresa-Anna J.-Tateman-Logan Tract-Gold Knob.*—Fourteen sets of split-check lessees are operating on the Theresa; of these lessees two sets are producing a good grade of ore, the other sets are all producing from medium- to low-grade ore. During the past year the Theresa shaft has been repaired and retimbered from surface to the 10th level.

Hansen & Co., working through the 8th level of the Theresa shaft, has drifted 500 feet on the contact between the granite and breccia on the Logan Tract. We consider this one of the most important developments in the Cripple Creek district.

The Tateman shaft is operated on a royalty lease by Lee Baker & Co., and just recently they have started to produce a small tonnage of better than average grade ore.

The Anna J. shaft is under lease to the Anna J. Leasing Co., and during the past year they have produced a fair tonnage of medium-grade ore.

*Vindicator.*—The Vindicator has 25 sets of lessees. Most of these lessees are producing medium- or low-grade ore, but two sets are producing a good grade of ore. The Vindicator accomplished more development work during 1938 than it has for the last several years. No work with the exception of the Cameron Tunnel drive is being done below 1,800.

*Wild Horse.*—The old Wild Horse shaft is leased to Judge Dickerson and associates and is being managed by F. G. Blackwood. The new or Gleason shaft has just recently been leased to Saddler and associates, and operations will be started about the first of the year.

*W. P. H. Group.*—The lower part of the W. P. H. has been under lease to The Doyle Diamond Drilling Co., and while no work was actually done on W. P. H. ground, development was carried on very close to the W. P. H. on Jerry Johnson ground, which could have easily been of great value to the W. P. H. This area has had very little development at depth. The operation was not a success, however, and has been discontinued.

The upper levels of the W. P. H. have been under lease to Jerry Johnson Gold, Inc. A small amount of work has been done by sublessee on this ground, working from the Jerry Johnson shaft, with a small production being made.

*Production of company ore by United Gold Mines Co. in 1938*

| Mine | Net tons | Gross value | Company ore cash receipts | Average gross value per ton | Number of cars shipped |
|---|---|---|---|---|---|
| Vindicator | 3,026 | $11,161.97 | $2,836.07 | $3.69 | 99 |
| Rose Nicol | 4,621 | 66,284.95 | 43,004.30 | 14.35 | 121 |
| Portland | 281 | 1,769.55 | 522.67 | 6.29 | 8 |
| | 7,928 | 79,216.47 | 46,363.04 | 9.99 | 228 |

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*Production of lessee ore of United Gold Mines Co. in 1938*

| Group | Net tons | Gross value | Royalties received | Lessees' receipts | Average gross value per ton | Number of cars |
|---|---|---|---|---|---|---|
| Vindicator | 27,740 | $289,862.70 | $81,463.73 | $97,119.13 | $10.45 | 859 |
| Rose Nicol | 8,507 | 76,064.74 | 13,559.01 | 26,540.55 | 8.94 | 264 |
| Theresa | 9,279 | 124,425.11 | 41,988.38 | 39,044.27 | 13.41 | 304 |
| W. P. H. group | 1,297 | 5,740.23 | 298.04 | 1,513.75 | 4.43 | 33 |
| Deadwood group | 20,810 | 228,417.55 | 18,450.84 | 107,128.65 | 10.98 | 625 |
| Londonderry group | 5,286 | 55,040.60 | 4,972.08 | 23,727.03 | 10.41 | 188 |
| Hardwood group | 4,751 | 56,398.21 | 5,107.81 | 26,684.01 | 11.87 | 124 |
| Empire group | 1,524 | 14,922.07 | 391.74 | 6,498.84 | 9.79 | 54 |
| Portland | 21,470 | 231,895.92 | 51,206.05 | 81,144.72 | 10.80 | 748 |
| Last Dollar | 12,748 | 120,859.80 | 37,966.15 | 35,061.93 | 9.48 | 408 |
| Hull City | 240 | 1,399.15 | 303.76 | 275.76 | 5.83 | 8 |
| | 113,652 | 1,205,026.08 | 255,707.59 | 444,738.64 | 10.60 | 3,615 |

*Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to Dec. 31, 1938*

| | Net tons | Gross value |
|---|---|---|
| Ore mined before consolidation | 26,310 | $456,806.19 |
| Production under operation of United Gold Mines Co | 1,716,591 | 18,656,295.99 |
| Total to Dec. 31, 1938 | 1,742,901 | 19,113,102.18 |

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1938 (dated February 1, 1939), says—

During the 12 months 63,533 dry tons of ore were shipped on company account, of a gross value of $466,821.89, averaging $7.35 per ton. The returns, less transportation and treatment of $220,775.30, were $246,046.59; giving the ore a net value of $3.87 per ton.

The company received as additional income the sum of $2,878.56 from interest and miscellaneous income. Net royalty of $239,547.29 on 68,890 tons lessee ore made a total of $488,472.44, with total expenses of $358,343.86, resulting in a net gain from operations of $130,128.58.

*Development*

| | *Feet* | *Feet* |
|---|---|---|
| Drifts and crosscuts: | | |
| Company | 6,069 | |
| Lessees | 1,459 | |
| | | 7,528 |
| Raises and winzes: | | |
| Company | 582 | |
| Lessees | 1,220 | |
| | | 1,802 |
| | | 9,330 |

The 18th level, which is 125 feet below the Roosevelt Drainage Tunnel, is at the present time producing the greater part of the company's tonnage. The ore from this level is low-grade, but the ore body is large and cheaply mined. This level should continue to produce a good tonnage throughout the year 1939.

A storage-battery locomotive has been installed and other improvements made in order to cut our haulage cost as much as possible.

Company work is being carried on from the 11th level down, and some ore is being produced on nearly every level. All workings have been maintained and kept open in order that they are accessible to any further operations.

Development work has been continued as in past years. During the past year, two new bodies of ore were opened on the 15th and 16th levels. Mining has not been started on either of these, so no estimate can be made on these ore bodies.

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Twenty-six sets of split-check lessees are working through the Cresson shaft, most of whom are producing some ore.

The ore produced by both company and lessees has kept the hoisting plant running to full capacity throughout the year.

The Dante and Gold Sovereign shafts are operated by F. G. Blackwood, under a royalty lease. Both have made a good production during the year.

No attempt has been made to lower the water beyond the 18th level. Some unwatering plan should be made in the near future in order to prospect the ground below.

Various taxes, such as payroll and others, are showing an increase every year and now account for a considerable part of the total mining costs. However, during the past year, our total mining costs decreased 21 cents per ton over the previous year.

For the past 5 years, we have attempted to carry on a safety campaign in order to cut down accidents. This has resulted in a new rate set-up for the Cresson mine of $5.37 per $100.00 of payroll, against $6.81 for previous years. This will result in a substantial saving for the year 1939.

The average cost per ton shipped by company and the lessees during 1938 was $2.731 on a total of 132,423 tons.

| | |
|---|---|
| Federal taxes | $0.060 |
| State income taxes | .020 |
| State and county taxes | .080 |
| Capital stock tax | .010 |
| Social-security tax | .028 |
| Unemployment tax | .046 |
| Compensation insurance | .100 |
| Insurance | .006 |
| Salaries of officers and directors | .040 |
| Colorado Springs office | .030 |
| Mining operations | 2.261 |
| Pumping | .040 |
| General expense | .010 |

*Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to Dec. 31, 1938*

| Period | Dry short tons | Gross value | Freight and treatment | Net value |
|---|---|---|---|---|
| 1903 to Dec. 31, 1937 | 2,587,807 | $40,127,179.24 | $12,783,552.28 | $27,343,626.96 |
| 1938: | | | | |
| Company ore | 63,533 | 466,821.89 | 220,775.20 | 246,046.59 |
| Lessee ore | 68,860 | 808,869.87 | 315,082.25 | 493,787.62 |
| 1903 to Dec. 31, 1938 | 2,720,220 | 41,402,871.00 | 13,319,409.83 | 28,083,461.17 |

| Period | Royalties received by company | Amount paid lessees | Average gross value per ton | Average net value per ton | Dividends |
|---|---|---|---|---|---|
| 1903 to Dec. 31, 1937 | | | $15.51 | $10.57 | $13,088,872.50 |
| 1938: | | | | | |
| Company ore | | | 7.35 | 3.87 | 97,600.00 |
| Lessee ore | $239,547.29 | $254,240.33 | 11.74 | 7.17 | |
| 1903 to Dec. 31, 1938 | | | 15.22 | 10.32 | [1] 13,186,472.50 |

[1] Represents 31.85 percent of gross value and 46.95 percent of net value.

The annual report of the Golden Cycle Corporation, dated February 15, 1939, for the calendar year ended December 31, 1938, contains the following paragraphs regarding the corporation's mining operations in the Cripple Creek district:

The Ajax shipped 53,040 tons with a gross value of $874,777.58, the freight and treatment amounting to $301,976.55. Since the Golden Cycle Corporation

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purchased the Ajax in August 1935, it has produced 155,697 tons with a gross value of $2,605,450.01, the freight and treatment charges amounting to $886,263.10.

Mining expenses for the year have been very high, due largely to the amount of water encountered in the new development work, resulting in a loss for the year of $66,502.22; however, the last 4 months of the year showed a profit, and it is hoped the year of 1939 will show an operating profit. 9,261 feet of drifts, crosscuts, and raises were driven during the year.

Ore was opened on the New Market vein system on both the 2,400-foot and 2,600-foot levels, and the drifts are being pushed on this ore on both levels. On the 2,300-foot level a new ore body was encountered on the Bob Tail vein. This has very good possibilities both on the 2,400-foot and 2,600-foot levels. New development on the 2,600-foot level was badly hampered on account of water conditions, and all new work done on 2,600-foot was very costly in comparison to work above in the dry.

Every effort has been made to reduce operating expenses on the Ajax mine. A new washing and sorting plant is now under construction that will make a very good saving on the cost of ore sorting. This plant will be in operation about March 1, 1939.

Direct pumping costs on the Ajax property alone, not including the many extra costs due to working in heavy flows of water, were $83,399.35 for the year. This shows very definitely the necessity of a new drainage tunnel or central pumping plant that will drain the water to a greater depth than any property in the district is now working, if a supply of ore for the mill is to be maintained in future years. It is impossible for the Cresson, Ajax, or Vindicator mines to go deeper than they are now working, handle the water they will encounter, and operate at a profit.

Within the next few weeks estimates on the cost of a new drainage tunnel some 900 feet deeper than the present tunnel will be prepared for your consideration. Surveys for such a tunnel are now being carried on.[3]

The Anchoria Leland mine shipped 7,980 tons of ore with a gross value of $86,955.03. Net profit before depletion was $16,092.44 for the year of 1938. The Blue Bird lease results were disappointing, as no ore that could be worked at a profit was found. Work was discontinued on this property and the lease surrendered.

Companies and individuals leasing mines on the Stratton Estate together produced 25,898 tons of ore in 1938, which brought a net return of $159,856 after freight and treatment charges are deducted. The principal producing mines, in approximate order of metal output, were the Logan, Block 107, Orpha May, American Eagles, and Geneva; the other producers comprised the Abe Lincoln, Blocks 47, 98, 192, and 219, Callie, Favorite, Longfellow, Los Angeles, Pikes Peak, Specimen, Matoa, Sacramento, and War Eagle. The total development work done at all mines on the Stratton Estate in 1938 was 8,470 feet.

The Free Coinage group continued to be an important producer in 1938. Part of the property was worked by Golden Conqueror Mines, Inc., and Gold Bullion Mines, Inc., in combination with leases on the United Gold Mines property, and part was operated by other lessees. The Lark Mining Co. was a steady shipper from the Queen and Forest Queen groups, operated under lease. The New Gold Dollar Mining Co. property was operated for the first 9 months of 1938 by the Trio Gold Mining Co. under a lease, and for the remainder of the year by the New Gold Dollar Mining Co., owner. The Elkton, Doctor Jack Pot, Empire Lee, Acacia, Jerry Johnson, and Irving Howbert (Ethel Louise) groups were operated continuously. Gold Producers, Inc., worked the Victor mine on the Smith Moffat property under lease and the company-owned El Paso group. The Queen Bess Mining Co. shipped considerable ore from the Black Belle group. The Tenderfoot Mining Co. continued developing the Mollie Kath-

[3] Driving of the tunnel was authorized by the Golden Cycle Corporation in March 1939.

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leen, Sangre de Cristo, and other groups on Tenderfoot Hill and shipped some ore. Cameron Mines, Inc., erected a 100-ton flotation mill at the Cameron shaft to treat low-grade sulfide ores from the Cameron and Pinnacle groups. The mill was run most of November and December, but not at capacity. The concentrates made were shipped to the Leadville smelter. The exploration and drainage tunnel begun by Cameron Mines, Inc., in 1937 to reach from the 2,000-foot level of the Vindicator shaft to the Isabella shaft had been driven approximately 1,000 feet by the end of 1938 and opened some ore on property of the United Gold Mines Co. Ore mined by the glory-hole system at the Iron Clad group was treated by cyanide leaching at the mine. During the year the Dooley Leasing Co. completed the purchase of the Rittenhouse group and shipped a substantial quantity of ore. Some of the other producing mines and dumps in the Cripple Creek district in 1938 were the Adney, Atlas (Midget-Bonanza King), Buckeye, Delmonico, Dolly Varden, Economic dump, Friday, Golden Swan group, Hamlet Dexter, Hiawatha, Index, Joe Dandy, Le Clair (Mary McKinney), Mary Nevin, Old Gold, Prince Albert, Rainbow, Ramona, Santa Rita Extension, School Section, Sheriff, and Strong.

Placer gold and high-grade specimen ore from the district, sold to assayers, refiners, and the Denver Mint, yielded 61 fine ounces of gold.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN AND CENTRAL STATES

(MINE REPORT)

By J. P. Dunlop and H. M. Meyer

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The most significant features of mining and milling in the Eastern States in 1938 were the large increase in production of gold in South Carolina, and the relatively small decrease in production of zinc compared with the large decrease in zinc reported in the Central and Western States. The dominating event in the Central States, aside from the great decline in output of lead and zinc, was the acquisition of all mines, leases, mills, power plant, and other equipment of the Commerce Mining & Royalty Co. in Oklahoma and Kansas by the Eagle-Picher Mining & Smelting Co. The output of silver, copper, and zinc from mines in the Eastern States decreased in 1938, but silver production in the Central States increased. No gold was reported produced by any mine in the Central States; the output of gold from mines in the Eastern States increased 9,247 ounces (owing mainly to an increase of 9,198 ounces in South Carolina), notwithstanding a decrease of 2,419 ounces in Alabama.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935-38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935-37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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*Mine production of gold, silver, copper, lead, and zinc in the Eastern and Central States in 1938, by States, in terms of recovered metals*

| State | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fine ounces | Value | Fine ounces | Value | Pounds | Value | Short tons | Value | Short tons | Value | |
| Eastern States: | | | | | | | | | | | | |
| Alabama | 300 | 41 | $1,435 | 4 | $3 | | | | | | | $1,438 |
| Georgia | 841 | 872 | 30,520 | 71 | 46 | 70 | $7 | | | | | 30,573 |
| Maryland | 1,701 | 855 | 29,925 | 24 | 16 | | | | | | | 29,941 |
| New Jersey | 528,595 | | | | | | | | | 85,839 | [1] $10,891,683 | [1] 10,891,683 |
| New York | 385,600 | | | 37,200 | 24,048 | | | [2] | [2] | 29,896 | 2,870,016 | [2] 2,894,064 |
| North Carolina | 26,157 | 1,878 | 65,730 | 5,500 | 3,556 | [4] | [4] | 4 | $368 | | | [5] 69,654 |
| Pennsylvania | [6] | 1,422 | 49,770 | 9,360 | 6,051 | [4] | [4] | | | | | [5] 55,821 |
| South Carolina | 59,930 | 11,681 | 408,835 | 3,951 | 2,554 | [4] | [4] | | | | | [5] 411,389 |
| Tennessee | 1,507,320 | 236 | 8,260 | 38,333 | 24,781 | [4] 21,079,090 | [4] 2,065,751 | [3] 7,896 | [3] 726,432 | [7] 56,766 | [7] 5,449,536 | [8] 8,274,760 |
| Virginia | 649,436 | 2,943 | 103,005 | 502 | 325 | [4] | [4] | [2] | [2] | [7] | [7] | [9] 103,330 |
| Total, 1937 | [10] 3,159,880 | 19,928 | 697,480 | 94,945 | 61,380 | 21,079,160 | 2,065,758 | 7,900 | 726,800 | 172,501 | 19,211,235 | 22,762,653 |
| | [10] 3,407,883 | 10,681 | 373,832 | 106,873 | 82,667 | 24,444,000 | 2,957,725 | 5,539 | 653,602 | 189,353 | 24,894,159 | 28,961,985 |
| Central States: | | | | | | | | | | | | |
| Arkansas | [11] | | | | | | | 7 | 644 | 152 | 14,592 | 15,236 |
| Illinois | [11] | | | 576 | 372 | | | 175 | 16,100 | | | 16,472 |
| Kansas | 3,751,300 | | | | | | | 15,239 | 1,401,988 | 73,024 | 7,010,304 | 8,412,292 |
| Kentucky | [11] | | | | | | | 101 | 9,292 | 322 | 30,912 | 40,204 |
| Michigan | 3,757,705 | | | 93,634 | 60,531 | 93,486,000 | 9,161,628 | | | | | 9,222,159 |
| Missouri | 4,148,000 | | | 292,000 | 188,768 | | | 122,027 | 11,226,484 | 10,226 | 981,696 | 12,396,948 |
| Oklahoma | 7,321,400 | | | | | | | 21,004 | 1,932,368 | 112,924 | 10,840,704 | 12,773,072 |
| Wisconsin | 58,700 | | | | | | | 320 | 29,440 | 2,073 | 199,008 | 228,448 |
| Total, 1937 | 19,037,105 | | | 386,210 | 249,671 | 93,486,000 | 9,161,628 | 158,873 | 14,616,316 | 198,721 | 19,077,216 | 43,104,831 |
| | 26,516,112 | 51 | 1,800 | 206,041 | 159,374 | 95,466,000 | 11,551,386 | 204,885 | 24,176,430 | 244,045 | 31,725,850 | 67,614,840 |

[1] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[2] New York and Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[3] Excludes value of lead, which is included under Tennessee.
[4] North Carolina, Pennsylvania, South Carolina, and Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[5] Excludes value of copper, which is included under Tennessee.
[6] Ore is pyritiferous magnetite, flotation copper concentrates from which yielded gold, silver, and copper; Bureau of Mines not at liberty to publish figures for ore and copper.
[7] Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.
[8] Includes also value of copper from North Carolina, Pennsylvania, South Carolina, and Virginia, lead from New York and Virginia, and zinc from Virginia.
[9] Excludes value of copper, lead, and zinc, which is included under Tennessee.
[10] Excludes pyritiferous magnetite ore from Pennsylvania.
[11] No figures available for small quantity of ore treated in Arkansas, Illinois, or Kentucky.

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*Number of lode and placer mines producing and yield of gold and silver in the Eastern States in 1938, by States*

| State | Number of mines | | Gold (fine ounces) | | Silver (fine ounces) | |
|---|---|---|---|---|---|---|
| | Lode | Placer | Lode [1] | Placer | Lode [1] | Placer |
| Alabama | 1 | 2 | 30 | 11 | 3 | |
| Georgia | 7 | 15 | 294 | 578 | 36 | 35 |
| Maryland | 2 | | 855 | | 24 | |
| New Jersey | 2 | | | | | |
| New York | 2 | | | | 37,200 | |
| North Carolina | 14 | 6 | 1,861 | 17 | 5,500 | |
| Pennsylvania | 1 | | 1,422 | | 9,360 | |
| South Carolina | 10 | 2 | 11,677 | 4 | 3,950 | 1 |
| Tennessee | 7 | | 236 | | 38,333 | |
| Virginia | 5 | 1 | 2,886 | 57 | 500 | 2 |
| Total, 1937 | 51 | 26 | [1] 19,261 | 667 | [1] 94,906 | 39 |
| | 39 | 40 | [1] 10,049 | 632 | [1] 106,843 | 30 |

[1] 1938: Dry and siliceous gold ores (88,671 tons) yielded 17,441 ounces of gold and 4,813 ounces of silver; copper ore (615,403 tons) yielded 375 ounces of gold and 42,470 ounces of silver; pyritiferous magnetite ore yielded 1,422 ounces of gold and 9,360 ounces of silver; zinc ore (1,530,295 tons) yielded no gold or silver; and zinc-lead ore (925,511 tons) yielded 23 ounces of gold and 38,263 ounces of silver.
1937: Dry and siliceous gold ores (60,542 tons) yielded 8,328 ounces of gold and 1,505 ounces of silver; copper ore (727,015 tons) yielded 373 ounces of gold and 53,491 ounces of silver; pyritiferous magnetite ore yielded 1,348 ounces of gold and 9,497 ounces of silver; zinc ore (1,679,334 tons) yielded no gold or silver; and zinc-lead ore (940,992 tons) yielded 42,350 ounces of silver.

*Gold.*—The production of gold in the Eastern States was 19,928 fine ounces in 1938, or 9,247 ounces more than in 1937. The output from siliceous ores increased from 8,328 ounces in 1937 to 17,441 ounces in 1938, that from placer mines from 632 to 667 ounces, and that from the refining of copper bullion from 1,721 to 1,797 ounces. Four gold-lode mines—two in South Carolina and one each in North Carolina and Virginia—produced more than 77 percent of the total gold recovered in the Eastern States in 1938. More lode mines but fewer placers were operated in 1938 than in 1937, and only two placers yielded more than 100 ounces of gold in 1938. The estimated output of gold in the Southern Appalachian States from 1799 to 1938, inclusive, is recorded as 2,532,776 fine ounces valued at $53,103,245.

In 1938, 88,671 tons of siliceous ore (from mines in Alabama, Georgia, Maryland, North Carolina, South Carolina, and Virginia) were treated, of which 87,615 tons went to gold and silver mills. Gold concentrates (542 tons) shipped to smelters yielded 2,497 ounces of gold, whereas bullion from gold milling plants yielded 13,894 ounces. Ore amalgamated (11,621 tons) yielded in bullion 1,633 ounces of gold and ore cyanided (75,994 tons) yielded 12,261 ounces. Only 1,056 tons of dry and siliceous ore were shipped crude to smelters; it yielded 1,050 ounces of gold.

Copper concentrates shipped to smelters yielded 1,632 ounces.

No mines in the Central States produced gold in 1938.

*Silver.*—Of the silver (94,945 fine ounces) produced in 1938 in the Eastern States, 39 ounces came from placer bullion, 3,709 ounces from bullion recovered at gold and silver mills, 82,048 ounces from concentrates smelted, and 9,149 ounces from ore shipped crude to smelters. Siliceous ores yielded 4,813 ounces of the silver; zinc-lead ores from New York, North Carolina, and Tennessee 38,263; copper ore 42,470; and copper concentrates recovered by flotation from pyritiferous magnetite ore 9,360 ounces.

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The production of silver in the Central States in 1938 was 386,210 ounces. The output of Illinois (576 ounces) came from galena concentrates recovered in milling fluorspar, that of Missouri (292,000 ounces) was derived from the refining of lead bullion, and that of Michigan (93,634 ounces) came from copper ore.

*Copper.*—The mine production of recoverable copper in the Eastern States was 21,079,160 pounds valued at $2,065,758 in 1938 compared with 24,444,000 pounds valued at $2,957,725 in 1937. The output from Tennessee was considerably less than in 1937 and that from Pennsylvania increased, but the Bureau of Mines is not at liberty to show the copper production of each State. Gold ore and concentrates shipped to smelters from Georgia, North Carolina, South Carolina, and Virginia yielded small quantities of copper, but most of the total was derived from copper ore mined in North Carolina and Tennessee and from copper concentrates recovered from Pennsylvania pyritiferous magnetite ore mined for its iron content. The output of copper from gold ore in 1938 was 16,570 pounds. Copper ore yielded about 0.0006 ounce of gold and 0.07 ounce of silver to the ton of crude ore. Copper concentrates from the magnetite ore contained about 22.5 percent copper and 0.11 ounce of gold and 1 ounce of silver to the ton.

The copper output of the Central States in 1938 came entirely from Michigan copper mines. The output of refined copper from Michigan decreased from 94,928,000 pounds in 1937 to 93,486,000 pounds in 1938, but the average recovery per ton of rock increased from 22.6 to 24.9 pounds.

*Lead.*—The recoverable lead produced from mines in the Eastern States in 1938 came from zinc-lead ores from the Austinville mine in Virginia, the Balmat mine in New York, the Embree mine in Tennessee, and the Silver Hill mine in North Carolina. Shipments of galena or lead carbonate concentrates totaled 12,018 tons and yielded 7,900 tons of lead, or 2,361 tons more than in 1937.

Lead recovered from shipments of lead ore and concentrates in the Central States decreased from 204,855 tons in 1937 to 158,873 tons in 1938 owing mainly to the decrease in shipments from southeastern Missouri, the largest lead-producing region in the United States, from 153,205 to 118,870 tons. Mines in the Tri-State or Joplin region shipped 51,751 tons of lead concentrates in 1938 compared with 65,765 tons in 1937.

*Zinc.*—The recoverable zinc in ore and concentrates shipped from mines in the Eastern States totaled 172,501 tons valued at $19,211,235 in 1938 compared with 189,353 tons valued at $24,894,159 in 1937. Mines in New Jersey yielded 85,839 tons as metal or in oxide.

[N. B.—The value of the zinc in New Jersey is the estimated smelting value of the recoverable zinc content of the ore after freight, haulage, smelting, and manufacturing charges are added.]

The output of recoverable zinc from New York mines decreased from 32,690 tons in 1937 to 29,896 tons in 1938; it was derived from zinc ore and zinc-lead ore. Zinc sulfide ores yielded all the zinc produced in Tennessee except that from zinc-lead carbonate ore of the Embree mine and copper ore of the Tennessee Copper Co. The recovered zinc content of sphalerite concentrates shipped from mines in Virginia may not be disclosed, but the total from concentrates shipped from

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Tennessee and Virginia in 1938 was 56,766 tons; there was an increase in the output of each State.

Zinc concentrates shipped from mines in the Central States had a recoverable zinc content of 198,721 tons in 1938 compared with 244,045 tons in 1937. Mines in the Tri-State region shipped ore and concentrates yielding 196,174 tons of zinc in 1938, Oklahoma contributing 58 percent and Kansas 37 percent. Stocks of sphalerite were negligible at the end of 1938. The recoverable zinc in shipments from Missouri mines decreased from 20,600 to 10,226 tons; in 1938 all the output came from southwestern Missouri, but in 1936 and 1937 small shipments of sphalerite were made from southeastern Missouri.

## MINE PRODUCTION IN THE EASTERN STATES

*Alabama.*—The quantity of gold produced in Alabama from 1830 to 1938, inclusive, has totaled 49,450 fine ounces. The output in 1938 was only 41 ounces compared with 2,460 ounces in 1937. The Hog Mountain mine, which had the largest output of gold in the Appalachian States in 1937, was idle in 1938. Production in 1938 was from two placer mines, in Tallapoosa and Talladega Counties, and from the Gold Log lode mine and mill in Talladega County, operated for a short period by the Guy S. Amos Mining Co.

*Georgia.*—From 1830 to 1938, inclusive, Georgia is reported as having produced 868,537 fine ounces of gold. In 1938, 15 placers and 7 lode mines yielded 872 ounces of gold and 71 ounces of silver. Of the 578 ounces of placer gold produced, 111 ounces came from mines near Dahlonega and Auraria in Lumpkin County, 425 ounces from mines near Sautee, Helen, and Nacoochee in White County, and the remainder from mines in Dawson, Hall, Cherokee, and Paulding Counties. The largest producers of placer gold were the Ferey Gold Mining Co. and the Dixie Gravel Co., both in White County. Gold recovered from 841 tons of siliceous ore amounted to 294 ounces and came mainly from the Hamilton mine in McDuffie County, operated by W. T. Fluker. The 10-stamp amalgamation-concentration mill was in operation for about 6 months on ore taken from two shafts; development work totaled about 690 feet. Various properties at Dahlonega controlled by Dr. Craig R. Arnold were leased or under option, and some should be productive in 1939. The Ferey Gold Mining Co. at Nacoochee, White County, the largest producer of gold in Georgia in 1938, operated its mine steadily all year by means of a dragline, trommel screen, and sluice boxes. The Simmons prospect near Buford, Gwinnett County, was worked by A. W. Amphlett Gold Mines. The Dixie Gravel Co. had a good output from the Dukes Creek placer mine, which was worked 120 days using a hydraulic elevator. The Shelley mine in Gwinnett County was operated about 10 months by Gavin D. McKay and J. B. McKay, and a 20-ton amalgamation-concentration plant was built. Some ore was milled, and a car of crude ore was shipped to Carteret, N. J. The shaft at the Shelley mine is 80 feet deep, and there are 150 feet of drifts. The Big Joe mine in Hall County was operated by Elmore Bish, and the bullion that was shipped was recovered by amalgamation at a small pilot mill; about 370 feet of drifting were done in 1938. A. D. Greenfield reopened the old Hobbs mine in Paulding County and made a small output. Gold bul-

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lion was shipped to the mint by T. F. Christian, J. S. Speer, and J. R. McDonald from various small operations in Lumpkin and Dawson Counties. R. H. Stumann, of Canton, shipped bullion purchased at small mines or prospects in Cherokee County. The Big Bunker Hill Mining Co. did not ship any bullion in 1938 but made extensive tests on its property and installed equipment to handle the saprolite by means of draglines and a log washing plant.

*Maryland.*—The total gold production of Maryland to the end of 1938 is estimated at 6,031 fine ounces. Until 1936 no gold had been produced in Maryland for many years, but in 1935 the Maryland Mining Co. did some development work in Montgomery County and in 1936 was the third largest producer of gold from gold ore in the Eastern States; in 1937 and 1938 it ranked fifth. The mine was worked nearly all of 1938; it is equipped with a 200-foot three-compartment shaft, and ore is mined at the 150- and 200-foot levels. The bullion sent to the mint was 950 fine and contained very little silver. The property controlled covers about 250 acres and is said to show numerous veins of good ore. Prospecting was done by Kirk & McNamara at the old Harrison mine and other prospects about 2½ miles from the Maryland mine. Two shafts were being sunk in November 1938, and some open-cuts were made. In one of these open-cuts a stringer of rich ore was found and panned. It yielded more than 40 ounces of gold. The bullion, which was sent to the Philadelphia Mint, had a fineness of 983. It is unusual for gold bullion to run even 950 fine, although some of the Georgia mines yield bullion of about that fineness.

*New Jersey* (see also second table of this chapter, footnote 1).—The production of zinc ore in New Jersey in 1938 was 528,595 tons containing 85,839 tons of recoverable zinc as metal or in oxide. The producing properties were the Sterling and Mine Hill mines; these mines were operated about 250 days in 1938 and have a much larger potential output.

*New York.*—The quantity of zinc ore mined and treated in New York decreased from 112,478 tons in 1937 to 105,000 tons in 1938 and that of zinc-lead ore from 352,392 to 280,600 tons. The total concentrates shipped yielded 29,896 tons of zinc and more than 2,000 tons of lead; the lead concentrates from the Balmat mine contain considerable silver also. The Balmat mine near Sylvan Lake produces zinc-lead ore, is equipped with a 1,250-ton all-flotation concentration plant, and has an enclosed shaft 1,300 feet deep. The Edwards mine has a vertical shaft 1,500 feet deep and an inclined shaft from the 1,500- to the 2,100-foot level. The all-flotation plant has a capacity of 550 tons. It is reported that the Universal Exploration Co. was doing some diamond drilling in St. Lawrence County in 1938.

*North Carolina.*—The gold output of North Carolina from 1799 to 1938, inclusive, is recorded as 1,154,677 fine ounces. The yield in 1938 was 1,878 ounces—1,861 ounces from 14 lode mines and 17 ounces from 6 placers. The output of silver was 5,500 ounces, of which 387 ounces came from dry gold ores, 206 ounces from zinc-lead ore, and the remainder from copper ore. The Fontana copper mine was the largest producer of silver and the third largest producer of gold in North Carolina in 1938, although the assay content of gold and silver is low. The largest producer of gold in North Carolina was the Capps

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mine in Mecklenburg County. The meager output of placer gold came from small mines or prospects in Cabarrus, Guilford, Halifax, Stanly, and Union Counties. The North Carolina Exploration Co. shipped high-grade crude sulfide copper ore from the Fontana mine in Swain County to the Tennessee Copper Co. smelter at Copperhill, Tenn. About 77 percent of the gold output of North Carolina came from the Capps mine; the Capps mill, a 125-ton cyanide plant, is near Charlotte in Mecklenburg County. Custom ore from a few mines in North Carolina and from the Terry, Ross-Carroll, Spartan, and Dixon mines in South Carolina was milled also at the Capps plant; this mill had the second largest gold output in the Appalachian States in 1938. The Rudisil mine and 50-ton flotation plant at Charlotte were closed in March 1938 after 35 months of operation, during which time the reported output was $130,000. The Silver Hill mine in Davidson County, which has been idle many years, was reopened by T. A. M. Stevenson in August 1938. The ore mined is zinc-lead containing copper, gold, and silver. There are several shafts at the mine, one of which is an inclined shaft of 725 feet. One old shaft was cleaned out, and a new prospect shaft was sunk. The property is equipped with a 10-stamp mill and Deister slime tables. Only a small quantity of ore was treated; some lead concentrates were shipped to Carteret, N. J., but the zinc concentrates were held for further treatment. Several cars of crude ore from the Dixie Queen mine in Cabarrus County were shipped by J. A. Terry to Carteret, N. J.; the ore contained gold, silver, and copper. The Tribro mine in Halifax County was worked 60 days by Passavant Bros., and a small amalgamation plant was constructed; the ore was mined from an open-cut and yielded good recoveries of gold. Several hundred tons of ore were mined by W. L. Cotton from the Mumford, Stewart, and Carter mines near Albemarle in Stanly County. Other small producing lode mines were the Porter in Union County, the Halifax in Franklin County, and the Spoon in Randolph County.

*Pennsylvania.*—The Cornwall mine and mill in Lebanon County were operated steadily throughout 1938; the mine has an open-cut and three inclined shafts 1,300 feet deep. The ore is pyritiferous magnetite, and the tailings from the iron concentrates go to the 2,000-ton flotation plant; the copper concentrates, which contain about 22.5 percent copper and 0.11 ounce of gold and 1 ounce of silver to the ton, were shipped to the Nichols Copper Co. The Reynolds Metal Co. had an option to purchase the old Friedensville zinc properties in Lehigh County but allowed the option to lapse in 1938.

*South Carolina.*—From 1829 to 1938, inclusive, mines in South Carolina produced 268,413 fine ounces of gold. In 1938 the output from ten lode mines and two placers was 11,681 ounces, of which only 4 ounces came from placers. Gold milling plants recovered 10,552 ounces of gold and 3,252 ounces of silver, and crude ore and concentrates shipped to smelters yielded 1,125 ounces of gold and 698 ounces of silver. The old Haile mine in Lancaster County, with a reputed total production of more than $3,000,000 in gold, was worked throughout 1938. Its production and that of the Terry mine largely accounted for the notable increase in the gold output from South Carolina and from the Southern Appalachian States. The small output of placer gold came from the Brewer mine in Chesterfield County

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and the Smith mine in York County. The Dorothy mine in York County was operated by the Thirty-Five Mining Co. until April 1938, and some crude ore was shipped to Carteret, N. J.; after April the mine was operated by W. H. Small, and 3 cars of crude ore were shipped to the Tennessee Copper Co. at Copperhill, Tenn. Among the mines in South Carolina that shipped ore to the Capps mill at Charlotte, N. C., were the Dixon and Ross-Carroll in York County and the Terry and Spartan in Cherokee County. The Ross-Carroll mine was operated 9 months by W. E. Tummon by means of open pits and trenches. Other production included that from the old Hegeler mine in Lancaster County, on which 200 feet of drifts were run; a few ounces of gold recovered in sampling the McGill and the Eustis mines in Cherokee County, both worked by H. M. Armstrong; and that from the Quinn prospect in York County, operated by R. B. Summerford. Crude ore from the McGill, Eustis, and Quinn was shipped to Carteret, N. J. The Terry mine near Smyrna was worked by Southern Gold, Ltd., for 11 months; two vertical shafts, 135 and 175 feet deep, were used to mine the ore, which was shipped partly to the Capps mill and partly to Carteret, N. J. The crude ore contains a little copper and silver, and the quantity of gold recovered was large considering the fact that the shipments of ore totaled less than 2,800 tons.

Haile Gold Mines, Inc., operated its mines and countercurrent decantation cyanide plant throughout 1938 and late in December completed a new mill unit that increased the daily capacity of the plant to about 400 tons. All the ore, which is a mixture of quartz and pyrite, is mined by open-cut methods. A new ore body was stripped by draglines, and ore was mined from two pits. The mines and mill comprise one of the most efficiently operated units in the Southern States, and although the ore is of comparatively low grade the ample reserves and low costs of mining, combined with efficient milling, have made the operations profitable. Geophysical exploration in 1938 indicated about 20 anomalies, and 28 churn- and 25 diamond-drill holes were finished in 1938. Twelve of these drill holes are on Red Hill. Drilling is being continued on other areas. The history of the Haile mine and its development and operation by the present owners have been described by Brodt and Newton.[1]

*Tennessee.*—Mines in Tennessee produced 19,475 fine ounces of gold from 1831 to 1938, inclusive; almost the entire output since 1906 has come from copper ore, and copper bullion was the sole source of the 236 ounces produced in 1938. The quantity of silver recovered in 1938 was 37,476 ounces from copper ore and 857 ounces from zinc-lead ore. The Embree Iron Co., the only producer of lead in Tennessee, shipped lead carbonate concentrates. The production of copper from Tennessee mines decreased about 1,600 tons from 1937 to 1938, but that of zinc increased about 475 tons.

The total output of copper from mines in Tennessee, North Carolina, South Carolina, Virginia, and Pennsylvania was 10,540 tons in 1938 compared with 12,219 tons in 1937; production increased in Pennsylvania, South Carolina, and Virginia. The total lead recovered from mines in New York, Tennessee, and Virginia was 7,896 tons in 1938 compared with 5,539 tons in 1937. The total zinc recovered from mines in Tennessee and Virginia was 56,766 tons in 1938 compared

[1] Brodt, H. H., and Newton, Edmund, Gold Mining at the Haile Mine in South Carolina: Min. Cong. Jour., vol. 24, No. 10, October 1938, pp. 20–27.

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with 55,255 tons in 1937; Virginia mines showed the larger increase. The Bureau of Mines is not at liberty to publish figures for the foregoing States separately.

The Tennessee Copper Co. ran its 1,200-ton (daily) flotation plant and its smelter, but not at capacity, on ore from the Burra Burra, Eureka, and Isabella mines in Tennessee and on sulfide ore from the Fontana mine in Swain County, N. C.; a few carloads of ore were received from other States. Some 48.2-percent zinc concentrates were produced at the mill and shipped to Donora, Pa., and the copper bullion was sent to the Nichols Copper Co. The Mascot mine and 2,600-ton concentrating plant of the American Zinc Co. of Tennessee were operated steadily in 1938; the mine is opened by a 520-foot shaft and an inclined shaft from the 520-foot level to the maximum depth of 850 feet. The output was larger in 1938 than in 1937. The company also worked the Grasselli mine, where operations were conducted at the 350-foot level. The crude ore from both mines was treated at the Mascot mill, which had been equipped with a differential-tension density cone that considerably increased the capacity of the plant. The Universal Exploration Co. worked steadily in 1938 at both the mine and 800-ton all-flotation mill, but the plant for treating zinc carbonate ore was idle throughout 1938. The average grade of the sphalerite shipped in 1938 was 64.765 percent zinc, which is considerably higher than that from any other mine in the United States. The Embree Iron Co. in Washington County shipped some zinc carbonate concentrates and increased its shipments of lead carbonate about 250 tons. A log washing plant was used to treat the crude ore. About 1 carload of zinc carbonate ore was shipped in 1938 by C. A. Wilson, of Jefferson City. Both the Mascot and Universal properties obtained much lower electric-power rates in October 1938, thereby reducing operating costs considerably.

*Virginia.*—Mines in Virginia produced 166,193 fine ounces of gold from 1828 to 1938, inclusive, but only 7,076 ounces have been produced during the last 28 years. In 1938 the output of the State was 2,943 ounces of gold and 502 ounces of silver from five lode mines and one placer. Shipments of both lead and zinc concentrates increased, but the Bureau of Mines is not at liberty to publish figures for lead and zinc output as the Austinville mine of the Bertha Mineral Co. is the only producer of zinc-lead ore in Virginia. The mine and 2,000-ton concentration-flotation mill were operated steadily throughout 1938.

Most of the gold produced in Virginia in 1938 came from the Vaucluse mine near Wilderness, Orange County. This mine has a vertical shaft 325 feet deep, and 435 feet of drifts were run in 1938. The sulfide ore is treated at a 75-ton all-flotation plant, and the concentrates are shipped to Carteret, N. J. The mine was worked from January to November, and then some exploration work was done on placer ground. The Red Bank mine near Virgilina, Halifax County, was operated 216 days by Joseph Hamme; the property is equipped with a small amalgamation plant. The Bull Neck lode-gold mine near McLean, Fairfax County, was idle in 1938. The Booker mine near Dillwyn in Buckingham County, which is equipped with a small amalgamation-concentration plant, was operated most of the year; bullion was shipped to the Philadelphia Mint and concentrates to

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Carteret, N. J. Some crude copper ore containing 15 percent copper and a little silver was shipped by the Nassog Co. from a prospect in Floyd County to Carteret, N. J. The placer-gold output of Virginia in 1938 came mainly from the Bertha and Edith mines in Goochland County, which were operated 5 months by means of a gasoline dragline by H. H. Walton, of Pendletons.

## MINE PRODUCTION IN THE CENTRAL STATES

*Quantity and tenor of ores.*—The only fair basis for comparing the relative magnitude of mining in different States is the quantity of crude ore or "dirt." The metal content of the ores of the several mining regions and States exhibits marked differences; therefore, comparison of tenor of the ores is interesting and significant. Virtually all the ore from the Central States is of such low tenor as to require concentration. In Kentucky and southern Illinois most of the lead and zinc concentrates are recovered as byproducts in the concentration of the fluorspar that they accompany, and the metal content of the crude ore raised cannot be calculated. In Arkansas very little ore has been mined for several years, and the average tenor calculated from the output of ore during these years would not offer accurate comparison with that during a period of active mining.

*Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in the Central States, 1936–38, by States*

| State [1] | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Ore, etc. | Metal content [2] | Ore, etc. | Metal content [2] | Ore, etc. | Metal content [2] |
| | *Short tons* | *Percent* | *Short tons* | *Percent* | *Short tons* | *Percent* |
| Kansas | 4,644,800 | 2.09 | 5,607,900 | 1.90 | 3,751,300 | 2.58 |
| Michigan | 3,225,600 | 1.49 | 4,197,881 | 1.13 | 3,757,705 | 1.24 |
| Missouri | 4,290,000 | 3.12 | 5,992,731 | 3.07 | 4,148,000 | 3.28 |
| Oklahoma | 9,085,600 | 1.84 | 10,432,000 | 1.77 | 7,321,400 | 1.71 |
| Wisconsin | 284,800 | 3.93 | 285,000 | 3.41 | 58,700 | 4.46 |
| | 21,530,800 | ---------- | 26,515,512 | ---------- | 19,037,105 | ---------- |

[1] No figures available for small quantity of ore treated in Arkansas, Illinois, or Kentucky.
[2] The percentages represent the metal content of the ore insofar as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in other Central States the metals are lead and zinc combined, the relative proportions of which are shown in the second table of this chapter and in the tables of tenor of ore given in the sections devoted to the respective States.

*Production of lead and zinc by regions.*—The report of this series for 1930 (chapter of Mineral Resources of the United States, 1930, pt. I) gives the areas included in the seven lead- and zinc-producing regions of the Central States. Mineral Resources, 1914, contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State from 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907. Subsequent records year by year are found in Mineral Resources and Minerals Yearbook.

Of a total of 360,504 tons of blende concentrates produced in 1938 in the Tri-State region, 59,987 tons, or 54,283 tons less than in 1937, were derived from old tailings.

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*Mine production of lead and zinc in the Central States in 1938, by regions*

| Region | Lead [1] | | Zinc [2] | | Total value |
|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | |
| Concentrates: | | | | | |
| Joplin or Tri-State | 51,751 | $2,682,767 | 361,526 | $11,100,690 | $13,783,457 |
| Southeastern Missouri | 163,500 | 9,040,593 | | | 9,040,593 |
| Upper Mississippi Valley [3] | 493 | 21,050 | [4] 3,895 | 121,180 | 142,230 |
| Kentucky-southern Illinois | 490 | 14,700 | 789 | 12,263 | 26,963 |
| Northern Arkansas | 10 | 500 | 437 | 8,500 | 9,000 |
| Total, 1937 | 216,244 | 11,759,610 | 366,647 | 11,242,633 | 23,002,243 |
| | 277,283 | 19,059,375 | 485,558 | 19,037,760 | 38,097,135 |
| Metal: | | | | | |
| Joplin or Tri-State | 39,400 | 3,624,800 | 196,174 | 18,832,704 | 22,457,504 |
| Southeastern Missouri | 118,870 | 10,936,040 | | | 10,936,040 |
| Upper Mississippi Valley [3] | 320 | 29,440 | 2,073 | 199,008 | 228,448 |
| Kentucky-southern Illinois | 276 | 25,392 | 322 | 30,912 | 56,304 |
| Northern Arkansas | 7 | 644 | 152 | 14,592 | 15,236 |
| Total, 1937 | 158,873 | 14,616,316 | 198,721 | 19,077,216 | 33,693,532 |
| | 204,885 | 24,176,430 | 244,045 | 31,725,850 | 55,902,280 |

[1] Includes galena and a small quantity of lead carbonate concentrates.
[2] Includes sphalerite and a small quantity of zinc carbonate and zinc silicate concentrates.
[3] Includes Iowa, northern Illinois, and Wisconsin.
[4] The zinc concentrates shipped in 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.

## REVIEW BY STATES

*Arkansas.*—A total of 437 tons of zinc carbonate and mixed zinc carbonate and sulfide was shipped from about seven mines in Arkansas in 1938 compared with 777 tons shipped from Arkansas mines in 1937; the recoverable zinc in the concentrates in 1938 was 152 tons. None of the mines gave any data for 1937 or 1938 on their operations or shipments, but the smelters that purchased the concentrates gave the information. Shipments of zinc concentrates were made from the McIntosh mines and Silver Hollow, Monte Cristo, and Red Cloud mines in the Rush district; other shipments were made of small lots purchased from scrappers in Newton County. The only shipments of lead concentrates from Arkansas in 1938 were about 10 tons from the Ponca district, purchased by the Eagle-Picher Mining & Smelting Co.; the recoverable lead content was 7 tons.

*Illinois.*—No lead or zinc mines in Illinois were operated in 1938. Shipments of galena from fluorspar mines in southern Illinois in 1938 totaled 294 tons with an average lead content of 60.9 percent; 175 tons of lead and 576 fine ounces of silver were recovered from these shipments compared with 186 tons of lead and 887 ounces of silver in 1937. The Aluminum Ore Co. and the Hillside Fluor Spar Mines were the largest shippers. The Mahoning Mining Co. operated churn drills near Cave in Rock, Hardin County, and developed a body of fluorspar-zinc-lead ore which contains more zinc than is normally found with fluorspar. Two shafts were sunk, and flotation tests showed that the crude ore was amenable to treatment to recover lead concentrates, zinc concentrates, and fluorspar of good grade.[2] A mill under construction in 1938 is expected to be operated in 1939.

*Kansas.*—Shipments of galena concentrates from mines in Kansas totaled 19,909 tons with a recoverable lead content of 15,239 tons compared with 20,559 tons with a recoverable content of 16,008 tons

[2] Clemmer, J. B., Duncan, W. E., DeVaney, F. D., and Guggenheim, M., Flotation of Southern Illinois Lead-zinc-fluorspar Ores: Bureau of Mines Rept. of Investigations 3437, 1939, 31 pp.

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in 1937. Shipments of sphalerite concentrates amounted to 133,546 tons with a recoverable zinc content of 73,024 tons in 1938 compared with 151,646 tons with a recoverable content of 80,300 tons in 1937. About 575,700 tons of Kansas crude ore were concentrated at mills in Oklahoma and yielded 45,204 tons of sphalerite concentrates and 6,217 tons of galena concentrates. In all, about 31 lead-zinc mines and 22 mills were operated in Kansas in 1938.

No output for 1938 was reported from the Lawton or Crestline camps, and little prospecting was done. Production in the Kansas part of the Waco area was mainly from tailings and from ore from the Acme mine treated by the B. H. & G. Mining Co. The old Acme mine was reopened early in 1938 and had a large output. The total output of the Waco area in 1938 was 103 tons of galena and 8,337 tons of sphalerite, of which properties in Kansas yielded 36 tons of galena and 5,772 tons of sphalerite. Some development work was done by the St. Louis Smelting & Refining Co. on its property at Waco, but the mines and 800-ton mill were idle. Operations at the Galena camp were confined to scrapping. Mines and mills near Baxter Springs shipped 4,184 tons of galena and 20,323 tons of sphalerite. The St. Louis Smelting & Refining Co. (mines and Ballard mill) was much the largest producer of both lead and zinc. Only a small quantity of old tailings was milled by the O. W. Bilharz Mining Co. Ore was mined and milled or shipped to custom mills from the Hocker, Robob, Wade, Iron Mountain, and Sunflower mines. Mines in the Blue Mound-Treece area shipped 15,659 tons of galena and 93,248 tons of sphalerite. Mines in Kansas that shipped ore to the Central mill at Cardin, Okla., included the Mid-Continent, Wright, Bendelari, Big John, Black Eagle, Silver Fox, and Northern. The Muncie mill of the Federal Mining & Smelting Co. resumed production in 1938. The larger producers in this area, other than those shipping to the Central mill, were: The Vinegar Hill Zinc Co. (Barr mine), Evans Wallower Zinc. Co. (No. 14), J. P. Dines Mining Co. (Blue Mound and Southern), American Zinc, Lead & Smelting Co. (Robinson), Commerce Mining & Royalty Co. (Wilber, Webber, and Chubb), the Cherokee mine, and the New Blue Mound mine. The four tailing mills in this area shipped 40 tons of galena and 13,782 tons of sphalerite; they were the Captain Milling Co., C. Y. Semple, Lewis Milling Co., and Youngman & Youse.

*Mine shipments of lead and zinc in Kansas, 1934–38*

| Year | Lead concentrates [1] | | Zinc concentrates | | Metal content [2] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lead | | Zinc | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 8,734 | $346,557 | 72,862 | $2,010,505 | 6,805 | $503,570 | 38,261 | $3,290,446 |
| 1935 | 14,301 | 579,690 | 102,078 | 2,948,509 | 10,892 | 871,360 | 54,110 | 4,761,680 |
| 1936 | 14,789 | 765,746 | 149,095 | 5,473,457 | 11,409 | 1,049,628 | 79,017 | 7,901,700 |
| 1937 | 20,559 | 1,454,507 | 151,646 | 6,476,064 | 16,008 | 1,888,944 | 80,300 | 10,439,000 |
| 1938 | 19,909 | 1,023,851 | 133,546 | 4,132,248 | 15,239 | 1,401,988 | 73,024 | 7,010,304 |

[1] Includes lead carbonate from Galena in 1934: 100 tons containing 63 percent lead.

[2] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the value of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

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*Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Crude ore | Old tailings | Crude ore | Old tailings |
| Total ore and old tailings milled ..... short tons | 2,081,300 | 3,526,600 | 2,044,500 | 1,706,800 |
| Total concentrates shipped: | | | | |
| Galena ..... do | 20,449 | 110 | 19,869 | 40 |
| Sphalerite ..... do | 120,233 | 31,413 | 116,213 | 17,333 |
| Ratio of concentrates to ore, etc.: | | | | |
| Lead ..... percent | 0.87 | ---------- | 0.97 | ---------- |
| Zinc ..... do | 5.23 | 0.89 | 5.15 | 1.01 |
| Metal content of ore, etc.: | | | | |
| Lead ..... do | .68 | ---------- | .76 | ---------- |
| Zinc ..... do | 3.15 | .53 | 3.46 | .61 |
| Average lead content of galena concentrates ..... do | 79.6 | 55.0 | 78.0 | 60.6 |
| Average zinc content of sphalerite concentrates .. do | 60.3 | 58.3 | 60.8 | 60.0 |
| Average value per ton: | | | | |
| Galena concentrates | $70.91 | $44.04 | $51.45 | $40.00 |
| Sphalerite concentrates | 42.64 | 42.80 | 30.60 | 33.22 |

*Kentucky.*—Seven mines in Kentucky shipped 218 tons of zinc carbonate, 571 tons of sphalerite, and 196 tons of lead carbonate in 1938. The zinc carbonate sold was shipped largely by Avery H. Reed of Marion and by C. F. Lester of Princeton, and the sphalerite was from the Eagle Fluor Spar Co. property. The bulk of the lead concentrates were shipped by Roberts & Frazer (Kentucky Fluor Spar Co.), the Klondike Fluorspar Corporation, and the Lafayette Fluorspar Co. The lead carbonate averaged about 52.6 percent lead and the sphalerite about 48 percent zinc. The recovered content of ore shipped was 101 tons of lead and 322 tons of zinc.

*Michigan.*—Copper production in many districts of the United States was considerably lower in 1938 than in 1937, but output in Michigan was relatively stationary during the 2 years. The Isle Royale Copper Co. resumed active operations in 1938; otherwise the producers were the same as in 1937—that is, Calumet and Hecla Consolidated Copper Co., Copper Range Co., and Quincy Mining Co. The decline in output at Calumet and Hecla in 1938 was counteracted by increased activity at the Copper Range and Quincy properties and by the production at Isle Royale. With resumption of treatment of tailings in 1935, the grade of ore treated in Michigan fell steadily until 1938, when the ratio of tailings to new ore declined; consequently the average grade of ore treated rose from 1.13 percent in 1937 to 1.24 percent in 1938. The 3,757,705 tons of rock and sands treated in 1938 yielded 93,486,000 pounds of copper, compared with 4,197,881 tons yielding 94,928,000 pounds in 1937.

The Peninsula Copper Co., organized by bondholders of the Seneca Copper Corporation, acquired the assets of the bankrupt Seneca company in May and optioned the property to Calumet and Hecla. This mine includes a large area adjacent to the openings in the Kearsarge lode at North Ahmeek, and, according to the Calumet and Hecla company, openings at Ahmeek indicate that copper mineralization on the Kearsarge lode extends to some degree at least into Peninsula territory. Results of the exploration work are somewhat encouraging.

The Isle Royale Copper Co. resumed shipment of rock to its mill in July. Mining is confined to Nos. 4 and 5 shafts where the bulk of

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the ore reserve is located. A description of operations at the Isle Royale mine was prepared by Eaton.[3]

The Quincy Mining Co., which reopened its mine in 1937, increased production in 1938. It was reported that the company was obtaining the highest yield of copper per ton of rock treated in many years (more than 34 pounds to the ton). Mining was proceeding on the 85th, 86th, and 87th levels of No. 6 shaft, which is opened to the 91st level.

*Mine production of gold, silver, and copper in Michigan, 1934–38* [1]

| Year | Gold (fine ounces) | Silver (fine ounces) | Copper [2] | | | Concentrate ("mineral") [3] | | Ore ("rock") (short tons) [4] |
|---|---|---|---|---|---|---|---|---|
| | | | Pounds | Yield | | Pounds | Yield (percent copper) | |
| | | | | Pounds per ton of ore ("rock") | Percent | | | |
| 1934 | 58.63 | [5] 529 | [6] 48,215,859 | [6] 68.9 | [6] 3.44 | [6] 70,102,754 | [6] 68.8 | [6] [7] 700,055 |
| 1935 | | 4,219 | 64,108,689 | 46.6 | 2.33 | 95,509,256 | 67.1 | 1,376,803 |
| 1936 | | | 95,968,019 | 29.8 | 1.49 | 141,166,376 | 68.0 | 3,225,600 |
| 1937 | 51.44 | 25,454 | 94,928,000 | 22.6 | 1.13 | 148,172,000 | 64.1 | [8] 4,197,881 |
| 1938 | | 93,634 | 93,486,000 | 24.9 | 1.24 | 144,964,890 | 64.5 | 3,757,705 |

[1] Figures based on actual recovery of copper from "mineral" smelted and estimated recovery from "mineral" not smelted during year.
[2] Includes copper from sands.
[3] Includes "mineral" from sands.
[4] Includes sands.
[5] According to Bureau of the Mint.
[6] No sands reported for 1934.
[7] Excludes 800 tons of ore amalgamated for recovery of gold and silver.
[8] Excludes 600 tons of siliceous ore.

*Value of silver and copper produced in Michigan mines, 1934–38*

| Year | Silver | Copper | | Total | Year | Silver | Copper | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | Per ton of ore ("rock") | | | | Total | Per ton of ore ("rock") | |
| 1934 | [1] $342 | $3,857,269 | $5.51 | $3,857,611 | 1937 | $19,689 | $11,486,288 | $2.74 | $11,505,977 |
| 1935 | 3,032 | 5,321,021 | 3.86 | 5,324,053 | 1938 | 60,531 | 9,161,628 | 2.44 | 9,222,159 |
| 1936 | | 8,829,058 | 2.74 | 8,829,058 | | | | | |

[1] According to Bureau of the Mint.

The following data are abstracted from reports of the companies to their stockholders.

Production of copper by the Calumet and Hecla Consolidated Copper Co. in 1938 totaled 48,264,000 pounds at an average cost sold (excluding depreciation and depletion) of 7.37 cents a pound. The Lake Linden and Tamarack reclamation plants curtailed production throughout the year by treating sand below the average grade of reserves and operating at 60 percent of capacity for 5 months of the year. Together they recovered 16,619,000 pounds of copper at an average cost sold (excluding depreciation and depletion) of 6.86 cents a pound. In 1937 the mines produced 53,876,000 pounds at an average cost of 7.59 cents a pound and the reclamation plants 20,398,000 pounds at 6.63 cents. Benefits from the small decrease in costs

[3] Eaton, Lucien, Reopening and Rehabilitating the Isle Royale Copper Mine: Min. Cong. Jour., vol 24, No. 10, October 1938, pp. 39–43.

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were more than wiped out by the lowering of the average price received from 14.11 cents a pound in 1937 to 10.03 cents in 1938. Exhaustion of the Conglomerate lode draws nearer with shafts Nos. 7 and 6 exhausted on September 30 and October 10, respectively, and exhaustion of No. 12 shaft expected during the summer of 1939.

*Operations at the Calumet and Hecla reclamation plants at Lake Linden and Hubbell in 1938 and for the entire period of their operation*

| | 1938 | Since starting |
|---|---|---|
| Quantity treated ---------- short tons | 1,934,000 | 31,098,000 |
| Assay headings ---------- percent | 0.517 | 0.666 |
| Assay tailings ---------- do | .085 | .128 |
| Refined copper produced ---------- pounds | 16,619,000 | 333,943,000 |
| Refined copper produced per ton treated ---------- do | 8.59 | 10.74 |

Of the 1938 production 5,288,000 pounds were from table treatment following grinding, 8,921,000 pounds from leaching, and 2,410,000 pounds from flotation. At the Calumet mill at Lake Linden 461,551 tons of Conglomerate rock were stamped. At the Ahmeek mill 667,412 tons of Kearsarge amygdaloid rock from the Ahmeek mine, 5,271 tons from No. 4 Kearsarge, and 8,876 tons from the Peninsula Copper Co. area were stamped. The smelter received 52,321 tons of concentrates, smelted 38,529 tons, and produced 46,418,962 pounds of refined copper. Copper oxide totaling 1,176 tons was shipped to customers. Results of explorations in the Mass-Michigan area in Ontonagon County were generally unfavorable.

The mine production of copper by the Copper Range Co. was 18,010,937 pounds, and copper produced at the tailings recovery plant amounted to 55,954 pounds, making a total of 18,066,891 pounds of copper. Of the copper produced, 1,618,986 pounds were from the Globe mine and the remainder from the Champion mine. Ore reserves at the Champion mine were reported to be about the same at the end as at the beginning of the year, but minable areas were more spotty and scattered. These conditions made mining more difficult and costs higher. The tailings recovery plant operated only 3 weeks in January owing to conditions in the copper industry and low metal prices. The plant is reported to be ready to resume operations on short notice. The average cost of production for the company was reduced from 11.45 cents a pound in 1937 to 9.50 cents in 1938, but as the average selling price fell from 12.375 to 9.80 cents there was a decline in the net realization per pound. Operations of the company for 5 years are shown in the following table.

*Copper produced by the Champion mine of the Copper Range Co., 1934–38*

| Year | Rock stamped | Copper produced | Yield per ton | Cost per pound [1] | Price received |
|---|---|---|---|---|---|
| | *Short tons* | *Pounds* | *Pounds* | *Cents* | *Cents* |
| 1934 | 241,175 | 13,929,859 | 57.76 | 8.69 | 8.55 |
| 1935 | 280,500 | 16,759,889 | 57.56 | 8.26 | 8.68 |
| 1936 | 320,815 | 17,486,019 | 54.51 | 8.87 | 9.59 |
| 1937 | [2] 306,075 | 16,131,277 | [3] 51.59 | 11.45 | 12.375 |
| 1938 [4] | 333,190 | 18,066,891 | 54.06 | 9.50 | 9.80 |

[1] Excludes depreciation and depletion.
[2] Excludes 133,594 tons of tailings treated.
[3] Yield from ore only.
[4] Includes Globe mine.



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*Missouri.*—The following tables show the shipments of lead and zinc in southwestern Missouri, which is part of the Tri-State region, and in southeastern Missouri. The tenor of the crude ore and concentrates is given for each area.

*Mine production of lead and zinc in southwestern Missouri, 1934–38*

| Year | Lead concentrates | | | | Zinc concentrates | | | | Metal content [1] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Galena | | Carbonate | | Sphalerite | | Silicate | | Lead | | Zinc | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 846 | $30,790 | 428 | $11,829 | 12,691 | $345,925 | 1,200 | $17,437 | 913 | $67,562 | 7,059 | $607,074 |
| 1935 | 490 | 19,600 | 345 | 10,350 | 13,020 | 371,980 | 1,400 | 20,561 | 552 | 44,160 | 7,263 | 639,144 |
| 1936 | 2,340 | 113,912 | 294 | 10,497 | 34,068 | 1,085,455 | 321 | 10,762 | 2,006 | 184,552 | 18,665 | 1,866,500 |
| 1937 | 5,587 | 368,231 | 173 | 8,160 | 37,715 | 1,611,158 | 1,690 | 43,411 | 4,426 | 522,268 | 20,589 | 2,676,570 |
| 1938 | 4,130 | 209,758 | 104 | 3,100 | 18,474 | 560,089 | 1,022 | 17,931 | 3,157 | 290,444 | 10,226 | 981,696 |

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

*Tenor of lead and zinc ore and old tailings treated and concentrates produced in southwestern Missouri, 1935–38*

| | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| Total ore and old tailings treated—short tons | [1] 554,300 | [2] 871,200 | [3] 980,100 | [4] 479,600 |
| Total concentrates in ore: | | | | |
| Lead—percent | 0.15 | 0.27 | 1.02 | 0.88 |
| Zinc—do | 2.60 | 3.95 | 5.82 | 4.07 |
| Metal content of ore: | | | | |
| Lead—do | .10 | .20 | .78 | .67 |
| Zinc—do | 1.49 | 2.40 | 3.47 | 3.00 |
| Average lead content of galena concentrates—do | 73.7 | 77.0 | 79.0 | 77.0 |
| Average lead content of lead carbonate concentrates—do | 60.0 | 63.0 | 63.0 | 50.0 |
| Average zinc content of sphalerite concentrates—do | 59.4 | 61.1 | 60.7 | 58.5 |
| Average zinc content of silicates and carbonates—do | 38.0 | 40.1 | 40.5 | 44.4 |
| Average value per ton: | | | | |
| Galena concentrates | $40.00 | $50.53 | $66.00 | $50.79 |
| Lead carbonate concentrates | 30.00 | 35.70 | 47.16 | 31.16 |
| Sphalerite concentrates | 28.57 | 32.20 | 43.30 | 30.26 |
| Zinc silicates and carbonates | 14.62 | 17.33 | 25.69 | 17.54 |

[1] Includes 364,000 tons of old tailings and slimes yielding 16 tons of galena concentrates and 5,840 tons of 58.3-percent sphalerite concentrates.
[2] Includes 408,700 tons of old tailings and slimes yielding 5 tons of galena concentrates and about 6,200 tons of 59.8-percent sphalerite concentrates.
[3] Includes 422,000 tons of old tailings yielding 40 tons of galena concentrates and 6,932 tons of 57.9-percent sphalerite concentrates.
[4] Includes 126,600 tons of old tailings and slimes yielding 1,420 tons of 55.8-percent sphalerite concentrates.

*Mine production of lead and zinc in southeastern Missouri, 1934–38*

| Year | Lead concentrates (galena) | | Zinc concentrates (sphalerite) | | Metal content [1] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lead | | Zinc | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 121,781 | $4,505,900 | -------- | -------- | 89,580 | $6,628,920 | -------- | -------- |
| 1935 | 131,405 | 5,638,005 | -------- | -------- | 96,941 | 7,755,280 | -------- | -------- |
| 1936 | 145,575 | 7,278,750 | 112 | $2,016 | 108,422 | 9,974,824 | 44 | $4,400 |
| 1937 | 209,937 | 14,360,271 | 24 | 720 | 153,205 | 18,078,190 | 11 | 1,430 |
| 1938 | 163,500 | 9,040,593 | -------- | -------- | 118,870 | 10,936,040 | -------- | -------- |

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

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*Tenor of lead ore and concentrates in southeastern Missouri disseminated-lead district, 1935–38*

| | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| Total lead ore.....short tons | 3,082,300 | 3,418,800 | 5,012,631 | 3,668,400 |
| Galena concentrates in ore.....percent | 4.26 | 4.26 | 4.18 | 4.45 |
| Zinc content of ore.....do | | | | |
| Average lead content of galena concentrates.....do | 73.3 | 76.0 | 74.5 | 74.8 |
| Average value per ton of galena concentrates | $42.91 | $50.00 | $68.42 | $55.29 |
| Average zinc content of sphalerite concentrates.....percent | | 45.0 | 51.6 | |
| Average value per ton of sphalerite concentrates | | $18.00 | $30.00 | |

The value of the silver, lead, and zinc shipped from Missouri mines was $12,396,948 in 1938 compared with silver, copper, lead, and zinc valued at $21,482,555 in 1937. The silver in 1938 (292,000 ounces) was recovered from lead refining; lead ore yielded no copper. The quantity of recovered lead decreased from 157,631 tons in 1937 to 122,027 tons in 1938 and that of recoverable zinc from 20,600 to 10,226 tons.

Shipments of lead concentrates (of which only 104 tons in 1938 and 173 tons in 1937 were lead carbonate) from Missouri mines were 167,734 tons compared with 215,697 tons in 1937; of the total, 163,500 tons were shipped from mines in southeastern Missouri compared with 209,937 tons in 1937, and the recovered lead content in southeastern Missouri was 118,870 tons in 1938 and 153,205 tons in 1937. No sphalerite was shipped in 1938 from southeastern Missouri. Shipments of lead concentrates from southwestern Missouri mines in 1938 comprised 4,130 tons of galena and 104 tons of lead carbonate; most of the galena concentrates were from mines in the Spring City, Oronogo, and Diamond camps.

The total value given for all concentrates is based on actual receipts by the sellers and not on quoted prices. In 1938, as in 1937, the quoted price was that paid for medium quantities or carload lots; small lots brought less.

The quoted price for 80-percent galena concentrates for the first 4 weeks of 1938 was $55 a ton. Early in February it declined to $49.43 and in April to $49 where it was pegged for 8 weeks. At the end of May the price declined further to $42.14, which held for 4 weeks. Late in June the quotation advanced to $49.34 and on the first of July to $55.10, which held for 9 weeks. In September the price advanced to $57.98 where it remained about 10 weeks. The quotation dropped late in November to $56.64 and in the first week in December to $52.94. The price during the last 2 weeks of 1938 was $54.38.

The quoted price of coarse sphalerite concentrates in 1938 ranged from $27.50 to $33.50 a ton. The opening quotation was $31.50, and in the sixth week the price declined to $29.50, which held for 6 weeks. At the end of March the quotation was $28.50, and early in April it dropped to as low as $27.50 where it stayed until the end of June. Early in July the price advanced to $30 where it was steady for 12 weeks. There was an upward swing in September, quoted prices reaching $31.50 in September and $32.50 in October. The high price of 1938 ($33.50) was reached early in November. News of the reduced import duty on zinc promptly caused a decline to $31 and then to $29, the quoted price for the last 4 weeks of 1938.

No prices were quoted for zinc silicate or lead carbonate concentrates. Flat purchase rates for the year were $31.14 a ton for

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lead carbonate and $17.54 for zinc silicate concentrates. There was no great demand for zinc silicates in 1938, and the production was only 1,022 tons.

The foregoing quoted prices apply to all mines in the Tri-State or Joplin region of Kansas, Missouri, and Oklahoma.

Few drill rigs were operated in the region in 1938, and most of them were in the old camps in southwestern Missouri. Development was most active in the Oronogo, Neck City, Waco, Stark City, and Joplin areas.

Of the 361,526 tons of zinc concentrates shipped from the Tri-State region in 1938, it is estimated that flotation concentrates comprised about 171,400 tons. Flotation galena concentrates are estimated at 8,800 tons. Since the extension of flotation the average grade of the galena concentrates has decreased, whereas that of the sphalerite has increased. Some of the galena from the jigs and tables has a lead content of 80 percent (and above), but the flotation galena does not average more than 70 percent. The small quantity of galena produced at tailing mills is of low grade, averaging 48 to 65 percent. About 50 large and small mines were worked in southwestern Missouri in 1938; only 16 mills were operated.

Small mining operations and churn drilling were handicapped by low prices for ore, and the work done was not particularly successful in most areas. Small bodies of ore were located but few of any size. A drilling campaign was started at the old Aurora camp in an endeavor to revive mining in that vicinity, which has been at a standstill for several years. The only fair-size body of good-grade ore was drilled by the Eagle-Picher Mining & Smelting Co. at Stark City. A shaft was sunk and ore shipped to the Central mill at Cardin, Okla., in December 1938. Another shaft is being sunk and drilling continued. Shipments of crude ore from this property probably will exceed 1,500 tons a week in 1939. An undertaking that involved good engineering and a large expenditure of money was that at the old Oronogo Circle mine, which has yielded ore worth many millions of dollars. Power shovels and trucks have been removing shale and waste from the large open cave and old underground workings. The work, which is being done by the Oronogo Mutual Mining Co., is still in progress, but late in December ore was being taken from open-cuts and trucked to a 250-ton concentrating plant built by the Eagle-Picher Mining & Smelting Co. to handle this ore and that of other mines at Oronogo, Neck City, and Alba.

Among the larger producers of concentrates in southwestern Missouri in 1938 were the Missouri Mining Co. at Chitwood and Mineral Recoveries at Webb City, both of which operate tailing mills. Large producers from crude ore were the Oronogo Mutual Mining Co., D. C. & E. mine, and F. M. Mining Co., at Oronogo; Federal Mining & Smelting Co., Spring City; Playter Mining Co., Waco; Burton Mining Co., Joplin; United Mines, Inc., Diamond; Webb City Lead-Zinc Co., Webb City; United Zinc & Lead Co. and Little Phoebe, Wentworth; and Mary Arnold Mining Co., Ozark. The largest shippers of zinc silicate were Pilant & Ogle of Granby. About 119,400 tons of crude ore from Missouri mines were shipped to the Central mill at Cardin, Okla. Other smaller producers were the Ritter Mining Co., Pflug

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Mining Co., Happy Hollow Mining Co., Luther Eakins, and Sterling Lead-Zinc Co.

The lead ore (3,668,400 tons) mined in 1938 in southeastern Missouri yielded 4.45 percent in galena concentrates averaging 74.8 percent lead. The mines and mills of the St. Joseph Lead Co., with a daily capacity of 20,500 tons, were operated at about 75 percent of capacity in 1938 and the Mine La Motte Corporation mine and mill at about the same rate. The Annapolis mine and mill in Iron County were operated part of the year by the Basic Metals Mining Co. The Ozark Lead Co. worked the Fleming tract at Fredericktown about 6 months in 1938. The crude ore was milled at the Clark & Hallock Milling Co. plant which was built in 1938. Mining was done on the 93-foot level, and the galena recovered was satisfactory in quantity and grade. Of the concentrates made at mills in southeastern Missouri, 73,884 tons were flotation galena concentrates in 1938 compared with 98,137 tons in 1937.

*Oklahoma.*—The most important event in Oklahoma and in the Tri-State lead and zinc region was the purchase by the Eagle-Picher Mining & Smelting Co. of virtually all of the 55,000 shares of the Commerce Mining & Royalty Co. The purchase was completed December 28, 1938, after many months of negotiations and a complete survey of all the Commerce properties. Eagle-Picher is now in possession of all lands, leases, mills, supplies, and equipment, as well as the large electric-power plant, of the company. The Northeast Oklahoma Ry. Co., which has numerous loading points in the Kansas and Oklahoma parts of the Tri-State region, will be operated by Eagle-Picher. The purchaser acquired large reserves of ore needed for its many integrated operations and an ample supply of crude ore for its 10,000-ton (daily) Central mill at Cardin. The field operating offices of the Eagle-Picher mine have been moved to Miami and Cardin. It is expected that the revamped Central mill, with its differential-tension density cone in good working condition, will be brought up to capacity and that the increased quantity of ore handled at that plant will permit the dismantling of several smaller mills. The large stocks of galena held by Commerce have been shipped to the Galena (Kans.) smelter. Little drilling was done in Oklahoma in 1938 for, although the ore reserves of many mines are nearing exhaustion, prices paid for concentrates have been too low to permit much money to be spent for exploration or development. Even if new bodies of ore are located it is improbable that any new milling plants will be constructed, as existing mills can handle more crude ore than is being mined.

About 30 mills of various sizes were operating in Oklahoma at the end of 1938. At least 65 operators did not mill their crude ore but shipped it to custom concentrating plants or central mills. The Tri-State Zinc & Lead Ore Producers Association reported that at the end of 1938 the stocks at mines in the Tri-State region were 8,402 tons of sphalerite and 8,620 tons of galena; all but 900 tons of the galena was shipped in January 1939, so that the total stocks of concentrates in mine bins were down to a little more than a week's demand over the current weekly output.

A large part of the concentrates from the tailing mills and from the central mills is a flotation product. The tailing mills produce very small quantities of low-grade galena, and the flotation galena at the

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large mills treating crude ore is of lower grade than the jig and table galena; on the other hand, much of the flotation sphalerite made is of higher grade than the coarse concentrates.

Nearly 1,177,000 tons more old tailings than crude ore were treated in Oklahoma in 1938, and the tailings yielded 20 percent of the sphalerite.

There was no production from the Peoria or Davis camps in 1938 or 1937. Mines near Commerce were operated part of the year, and the Cactus and Lost Trail leases produced galena and sphalerite at small mills or shipped crude ore to custom mills. The shippers in the Sunnyside-Quapaw area were the Kansas & Oklahoma Mining Trust, Atlas Milling Co., Century Zinc Co. (Scott), and St. Louis Smelting & Refining Co. (No. 4). In the central and western parts of the Oklahoma section of the Tri-State region the following mills were run partly on ore and partly on tailings: Lawyers Lead & Zinc Co., Skelton Lead & Zinc Co., Evans Wallower Zinc, Inc., and Rialto Mining Corporation. The following mills treated tailings only: Cardin Mining & Milling Co. (Nos. 2 and 3), Commerce Mining & Royalty Co. (Beaver), Britt Mining Co., Tri-State Zinc, Inc. (two mills), Andrews Mining & Milling Co., Cortez King Brand Mining Co., and C. Y. Semple. The Eagle-Picher Mining & Smelting Co.—Central and Mary M. Beck mills—treated more crude ore than any other operator in the region; its mills and the Bird Dog, See Sah, and Blue Goose mills of the Commerce Mining & Royalty Co. treated about two-thirds of all the Oklahoma crude ore milled in 1938. Other large outputs were made by the Rialto Mining Corporation, Evans Wallower Zinc, Inc. (No. 4), Oklahoma Interstate Mining Co. (Woodchuck), United Zinc Smelting Corporation, Kansas Exploration Co. (Ritz), Guaranty Mining & Royalty Co., Cortez King Brand Mining Co. (New York and Oberman mines), Indian Mining & Milling Co., Black Mining Co., Lula Belle Mining Co., Baird Mining Co., Blue Ribbon Mining Co., Federal Mining & Smelting Co. (Gordon), and Lavrion Mining Co.

Some of the larger shippers in Oklahoma to custom or central mills were the Davis Big Chief Mining Co., Craig Mining Co., Cameron & Henderson, J. Dryer, Henderson Mining Co., Andrews Mining Co., Childress Mining Co. (Acme), Southeastern Mining Co. (Hope), New Deal Mining Co., Romo Mining Co., Tongaha Mining Co., Gray Wolf Mining Co., and Needmore Mining Co. The Bird Dog mill received ore from many of the leases belonging to the Commerce Mining & Royalty Co., including the Anna Beaver and Scammon Hill mines. Virtually all the tailings treated were handled by gasoline power shovels, the remainder by draglines. The new 1,200-ton Gordon mill of the Federal Mining & Smelting Co., which was completed in November 1937, treated all ore mined by the company in Oklahoma. The Mary M concentrating plant received custom ores from 8 mines, and the Royal plant from about 10 mines including the Mary Alice, Hope, Aztec, and Indiana.

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*Mine shipments of lead and zinc in Oklahoma, 1934–38*

| Year | Lead concentrates (galena) | | Zinc concentrates (sphalerite) | | Metal content [1] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lead | | Zinc | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 21,889 | $851,523 | 204,283 | $5,523,966 | 16,747 | $1,239,278 | 107,772 | $9,268,392 |
| 1935 | 30,790 | 1,329,656 | 246,131 | 7,047,052 | 23,405 | 1,872,400 | 129,763 | 11,419,144 |
| 1936 | 34,833 | 1,735,732 | 244,740 | 7,628,448 | 25,427 | 2,339,284 | 129,175 | 12,917,500 |
| 1937 | 39,446 | 2,729,690 | 255,839 | 10,428,354 | 29,840 | 3,521,120 | 135,696 | 17,640,480 |
| 1938 | 27,608 | 1,446,058 | 208,484 | 6,390,422 | 21,004 | 1,932,368 | 112,924 | 10,840,704 |

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

*Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Crude ore | Old tailings and slimes | Crude ore | Old tailings and slimes |
| Total ore, etc., milled—short tons | 3,787,600 | 6,644,400 | 3,072,400 | 4,249,000 |
| Total concentrates shipped: | | | | |
| Galena—do | 38,906 | 540 | 27,208 | 400 |
| Sphalerite—do | 191,046 | 64,793 | 167,250 | 41,234 |
| Ratio of concentrates to ore, etc: | | | | |
| Lead—percent | 1.03 | | 0.91 | 0.01 |
| Zinc—do | 5.15 | 0.98 | 5.30 | .97 |
| Metal content of ore, etc.: | | | | |
| Lead—do | .80 | | .71 | |
| Zinc—do | 3.11 | .60 | 3.19 | .58 |
| Average lead content of galena concentrates—do | 77.4 | 60.0 | 78.0 | 52.0 |
| Average zinc content of sphalerite concentrates—do | 60.3 | 60.1 | 60.2 | 60.1 |
| Average value per ton: | | | | |
| Galena concentrates | $69.45 | $51.05 | $52.62 | $35.79 |
| Sphalerite concentrates | 40.80 | 40.65 | 30.61 | 30.83 |

*Mine production of lead and zinc concentrates in Oklahoma, 1891–1938, by districts*

| District | Lead concentrates (mainly galena) | | Zinc concentrates | | | |
|---|---|---|---|---|---|---|
| | | | Sphalerite | | Zinc silicate and carbonate | |
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Davis | | | 558 | $27,399 | 899 | $24,592 |
| Miami [1] | 1,240,581 | $101,770,268 | 7,081,483 | 277,355,069 | 164 | 2,692 |
| Peoria | 2,639 | 127,163 | 220 | 8,289 | 3,120 | 79,649 |
| | 1,243,220 | 101,897,431 | 7,082,261 | 277,390,757 | 4,183 | 106,933 |

[1] Including Quapaw and Sunnyside.

*Wisconsin.*—The output of galena concentrates in 1938 in Wisconsin was less than one-third of that in 1937. Shipments of sphalerite decreased substantially, and the grade of the raw concentrates was lower; the recovered zinc decreased 4,865 tons. About half the raw concentrates were treated at the Cuba City roasting plant, which was

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abandoned early in 1938, and the rest were treated at a flotation plant built in 1938. The Vinegar Hill Zinc Co. worked the Mullen No. 2 and Winskill-Petersen mines 90 days, closing them in March 1938. Small lots of crude ore were shipped to the Vinegar Hill concentrating plants from about 30 small mines at Shullsburg, New Diggings, Linden, Highland, Hazel Green, Dodgeville, Cuba City, and Benton. The shippers included the McKinley Mining Co., which did not operate its mill in 1938. The Pacquette mine at Shullsburg, operated by C. J. Rodham, produced no ore, but a new shaft was sunk and flotation equipment was added to the concentrating plant.

*Mine production of lead and zinc in Wisconsin, 1934–38*

| Year | Lead concentrates | | Zinc concentrates (sphalerite) | | Metal content [1] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lead | | Zinc | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 340 | $12,586 | 31,489 | $365,839 | 234 | $17,316 | 9,807 | $843,402 |
| 1935 | 398 | 16,963 | 33,027 | 379,262 | 286 | 22,880 | 8,923 | 785,224 |
| 1936 | 1,277 | 61,198 | 38,276 | 400,899 | 904 | 83,168 | 8,126 | 812,600 |
| 1937 | 1,590 | 109,468 | 37,060 | 444,531 | 1,091 | 128,738 | 6,938 | 901,940 |
| 1938 | 493 | 21,050 | [2] 3,895 | 121,180 | 320 | 29,440 | 2,073 | 199,008 |

[1] In calculating the metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.
[2] The zinc concentrates shipped in 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.

*Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1935–38*

| | | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Total ore | short tons | 236,000 | 284,800 | 285,000 | 58,700 |
| Total concentrates in ore: | | | | | |
| Lead | percent | 0.17 | 0.45 | 0.56 | 0.84 |
| Zinc | do | 14.00 | 13.44 | 13.00 | [1] 6.64 |
| Metal content of ore: | | | | | |
| Lead | do | .12 | .32 | .29 | .55 |
| Zinc | do | 4.85 | 3.61 | 3.12 | 3.91 |
| Average lead content of galena concentrates | do | 73.3 | 72.2 | 70.1 | 67.0 |
| Average zinc content of sphalerite concentrates | do | 34.6 | 27.0 | 24.0 | 18.5 |
| Average value per ton: | | | | | |
| Galena concentrates | | $42.62 | $48.08 | $68.85 | $42.70 |
| Sphalerite concentrates | | 11.48 | 10.47 | 11.99 | [2] |

[1] The zinc concentrates shipped in 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.
[2] Not given.

The raw sphalerite concentrates averaged about 18.5 percent zinc and were treated at either a roasting plant or flotation plant to make a product, containing about 59.2 percent zinc, which was shipped to smelters and brought an average price of $31.11 a ton. Flotation concentrates made in 1938 comprised 788 tons of 60-percent zinc concentrates and 155 tons of 60-percent galena concentrates.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By T. H. MILLER AND PAUL LUFF

## SUMMARY OUTLINE


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The total value of the metal output from mines in Idaho in 1938 decreased $8,812,081, or 23 percent, from that in 1937. The value of the lead output declined $3,757,614; silver, $2,872,397; zinc, $2,818,990; and copper, $120,900. The value of the gold output increased $757,820. The decreases in average sales prices of lead, silver, and zinc in 1938 caused curtailment or suspension of operations at the large zinc-lead properties in the Coeur d'Alene region, the chief metal-producing area in Idaho; however, the output of zinc-lead ore from the Warm Springs district in Blaine County increased 51 percent. Production of gold in Idaho in 1938 (103,513 fine ounces) was the largest since 1896, owing to increased output from both lode mines and placers, and that of silver (18,993,676 fine ounces) was only 3 percent less than the record output of 1937; but the output of zinc declined 19 percent and that of lead 11 percent.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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*Mine production of gold, silver, copper, lead, and zinc in Idaho, 1934–38, and total, 1863–1938, in terms of recovered metals*

| Year | Mines producing | | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 291 | 1,172 | 1,287,182 | 84,817.20 | $2,964,361 | 7,394,143 | $4,780,052 |
| 1935 | 289 | 1,079 | 1,520,945 | 83,823.06 | 2,933,807 | 10,240,953 | 7,360,685 |
| 1936 | 281 | 828 | 1,807,530 | 80,291.40 | 2,810,199 | 14,537,530 | 11,259,317 |
| 1937 | 347 | 741 | 2,075,402 | 81,861.00 | 2,865,135 | 19,587,766 | 15,151,137 |
| 1938 | 305 | 463 | 1,999,147 | 103,513.00 | 3,622,955 | 18,993,676 | 12,278,740 |
| 1863–1938 | | | (1) | 7,216,200.00 | 155,706,403 | 418,127,937 | 286,172,222 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 1,531,625 | $122,530 | 142,648,216 | $5,277,984 | 49,598,651 | $2,132,742 | $15,277,669 |
| 1935 | 2,095,867 | 173,957 | 158,040,250 | 6,321,610 | 62,105,568 | 2,732,645 | 19,522,704 |
| 1936 | 2,954,000 | 271,768 | 182,678,000 | 8,403,188 | 98,200,000 | 4,910,000 | 27,654,472 |
| 1937 | 4,464,000 | 540,144 | 207,422,000 | 12,237,898 | 108,398,000 | 7,045,870 | 37,840,184 |
| 1938 | 4,278,000 | 419,244 | 184,354,000 | 8,480,284 | 88,060,000 | 4,226,880 | 29,028,103 |
| 1863–1938 | [2] 88,273 | 28,177,989 | [2] 5,217,325 | 556,935,252 | [2] 676,133 | 93,089,861 | 1,120,081,727 |

[1] Figures not available. [2] Short tons.

*Gold and silver produced at placer mines in Idaho, 1934–38, in fine ounces, in terms of recovered metals*

| Year | Sluicing and hydraulic | | Drift mining | | Dragline dredges [1] | | Floating (bucket) dredges | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| 1934 | [2] 8,155.62 | [2] 2,350 | (2) | (2) | 3,248.70 | 593 | 15,852.05 | 5,585 | 27,256.37 | 8,528 |
| 1935 | [2] 8,134.07 | [2] 2,641 | (2) | (2) | ---------- | ------ | 23,616.96 | 9,544 | 31,751.03 | 12,185 |
| 1936 | [2] 8,282.46 | [2] 1,473 | (2) | (2) | 49.15 | 19 | 26,098.19 | 9,661 | 34,429.80 | 11,153 |
| 1937 | 4,286.00 | 1,399 | 433.00 | 65 | 6,859.00 | 1,652 | 28,962.00 | 9,171 | 40,540.00 | 12,287 |
| 1938 | 4,987.00 | 969 | 410.00 | 57 | 17,448.00 | 6,202 | 31,234.00 | 10,100 | 54,079.00 | 17,328 |

[1] Power-shovel excavators with floating washing plants or special amalgamators.
[2] Figures for sluicing and hydraulic include those for drift mining.

*Gold.*—The output of recoverable gold in Idaho was 26 percent greater in 1938 than in 1937 and was the largest since 1896 when it was 112,409 ounces. Gold output from lode mines increased 20 percent and that from placers 33 percent; most of the gain in gold from placers came from dragline operations. About 52 percent of the State total gold output in 1938 came from placer operations; 30 percent of the total lode and placer was recovered by connected-bucket dredges and 17 percent by dragline dredges. Nine floating (bucket) dredges treated a total of 6,693,700 cubic yards of gravel and recovered 31,234 ounces of gold, an increase of 2,272 ounces over 1937; and 19 dragline dredges treated a total of 2,173,000 yards of gravel and recovered 17,448 ounces of gold, an increase of 10,589 ounces. Of the total placer gold, 82 percent came from the Boise Basin, Warren, Carson, Newsome, and West View (Gem County) districts where dredges were operated. Gold from placer and lode

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operations in the Boise Basin district comprised 26 percent of the State total. About 79 percent of the lode gold came from the Boise Basin, Marshall Lake, Middle Boise, Warm Springs, Yellow Pine, Ten Mile, Ramey Ridge, Mineral Hill, and Orogrande districts and the Coeur d'Alene region. Increases in gold were recorded in the Middle Boise, Warm Springs, Mineral Hill, Ramey Ridge, and Ten Mile districts, but decreases in the Seven Devils and Yellow Pine districts. Siliceous gold ore and old tailings yielded 39 percent of the total gold in 1938.

The Fisher-Baumhoff Co., operating two bucket dredges near Centerville, was again the largest gold producer in Idaho. It was followed by the Moores Creek Dredging Co. at Idaho City; the Golden Anchor mine at Burgdorf; the Warren Dredging Co. at Warren; Newsome Creek Placers near Golden; the Jordan Creek dredge at De Lamar; the Triumph (Snyder Mines, Inc.) mine near Hailey;

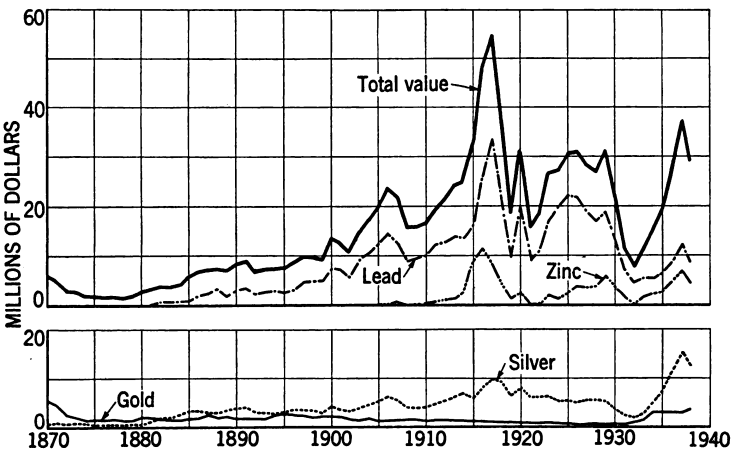


FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1938. The value of copper has been less than $2,000,000 annually except in a few years.

Ralph Davis, Inc. (dredge), at Montour; the Yellow Pine Co. at Stibnite; the Mayflower mine at Placerville; and the Boise-Rochester property at Atlanta.

*Silver.*—The output of recoverable silver in Idaho was 18,993,676 fine ounces in 1938, a decrease of 3 percent from the record output of 1937. Virtually all the large producers of silver in the Coeur d'Alene region reported decreases except the Polaris mine which reported a substantial gain. There was also a substantial increase in silver output from the Warm Springs district. The Coeur d'Alene region produced 91 percent of the State total silver in 1938; the remainder came chiefly from the Warm Springs, Bayhorse, Blue Wing, Pend d'Oreille, Boise Basin, Carson, and Middle Boise districts. Silver ore yielded 72 percent of the State total silver, zinc-lead ore 19 percent, and lead ore 8 percent. Production of silver from silver ore decreased 519,213 ounces and that from lead ore also decreased, but the output from zinc-lead ore increased 469,709 ounces.

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The Sunshine mine, largest producer of silver in the United States, decreased its output from 12,152,000 ounces in 1937 to 11,352,154 ounces in 1938. Eight mines—the Sunshine, Polaris, Bunker Hill, Hecla, Triumph, Morning, Crescent, and Page—produced 94 percent of the silver output of the State in 1938. All these mines, except the Triumph, are in the Coeur d'Alene region.

*Copper.*—The output of recoverable copper in Idaho was 4,278,000 pounds in 1938, a decrease of 4 percent from 1937. Mines in the Coeur d'Alene region produced 88 percent of the total (nearly 72 percent from silver ore, 12 percent from zinc-lead ore, 4 percent from lead ore, and a little from gold ore); 5 percent came from gold ore from the McDevitt and Ramey Ridge districts. The Sunshine mine produced more than half the State total copper in 1938; most of the remainder came from the Polaris, Bunker Hill, Copper Queen, and Morning mines.

*Lead.*—The output of recoverable lead in Idaho was 184,354,000 pounds in 1938, a decrease of 11 percent from 1937. More than 89 percent of the total came from the Coeur d'Alene region and 8 percent from the Warm Springs district; considerable lead was produced also in the Bayhorse, Pend d'Oreille, Port Hill, and Texas districts. Zinc-lead material from the Coeur d'Alene region and the Warm Springs district yielded 75 percent of the State total lead in 1938; lead ore, chiefly from the Coeur d'Alene region, yielded 23 percent. Lead recovered from lead ore decreased 20,895,011 pounds and that from zinc-lead material 2,611,776 pounds. The combined lead output of the three largest producers—Bunker Hill, Hecla, and Morning—was 134,740,600 pounds, or 73 percent of the State total; other large producers of lead were the Triumph, Page, Star, Sherman, Gold Hunter, Blackhawk, Clayton, and Jack Waite properties.

*Zinc.*—The output of recoverable zinc in Idaho was 88,060,000 pounds in 1938, or 19 percent less than the record output of 1937. The decrease was due entirely to curtailment of operations at zinc-lead mines in the Coeur d'Alene region, as the output of zinc from the Warm Springs district increased from 13,918,000 pounds in 1937 to 24,140,000 pounds in 1938. More than 72 percent of the State total zinc in 1938 came from the Coeur d'Alene region and nearly all the remainder from the Warm Springs district. Three mines—the Morning, Triumph, and Bunker Hill—produced 77 percent of the State total, and the rest came chiefly from the Star, Frisco, Page, and Hecla mines. Zinc-lead ore and old tailings yielded 99 percent of the total and lead ore the remainder.

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## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Idaho in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value |
| Ada | 3 | 10 | 577 | $20,195 | 113 | $73 |
| Adams | 5 | 2 | 293 | 10,255 | 382 | 247 |
| Benewah | | 1 | 4 | 140 | | |
| Blaine | 24 | 2 | 5,055 | 176,925 | 1,059,993 | 685,248 |
| Boise | 36 | 75 | 27,730 | 970,550 | 49,828 | 32,212 |
| Bonner | 9 | | 65 | 2,275 | 62,899 | 40,662 |
| Bonneville | 1 | 4 | 124 | 4,340 | | |
| Boundary | 3 | | 34 | 1,190 | 14,041 | 9,077 |
| Butte | 3 | | 141 | 4,935 | 20,298 | 13,122 |
| Camas | 5 | 2 | 442 | 15,470 | 1,086 | 702 |
| Canyon | | 1 | 3 | 105 | | |
| Cassia | 1 | | | | 96 | 62 |
| Clark | 1 | | | | 3 | 2 |
| Clearwater | 2 | 42 | 1,101 | 38,535 | 229 | 148 |
| Custer | 19 | 13 | 461 | 16,135 | 180,610 | 116,758 |
| Elmore | 16 | 31 | 7,103 | 248,605 | 39,566 | 25,578 |
| Gem | 4 | 5 | 4,049 | 141,715 | 4,288 | 2,772 |
| Gooding | | 2 | 8 | 280 | | |
| Idaho | 63 | 130 | 32,903 | 1,151,605 | 38,627 | 24,971 |
| Jerome | | 11 | 266 | 9,310 | 17 | 11 |
| Kootenai | | 1 | 2 | 70 | | |
| Latah | | 11 | 55 | 1,925 | | |
| Lemhi | 38 | 54 | 6,293 | 220,255 | 78,374 | 50,666 |
| Lewis | | 1 | 6 | 210 | | |
| Nez Perce | | 6 | 72 | 2,520 | 17 | 11 |
| Owyhee | 21 | 12 | 7,726 | 270,410 | 50,473 | 32,629 |
| Power | | 4 | 24 | 840 | | |
| Shoshone | 43 | 20 | 4,053 | 141,855 | 17,325,379 | 11,200,245 |
| Twin Falls | | 6 | 85 | 2,975 | 3 | 2 |
| Valley | 7 | 16 | 4,832 | 169,120 | 33,001 | 21,334 |
| Washington | 1 | 1 | 6 | 210 | 34,353 | 22,208 |
| Total, 1937 | 305 | 463 | 103,513 | 3,622,955 | 18,993,676 | 12,278,740 |
| | 347 | 741 | 81,861 | 2,865,135 | 19,587,766 | 15,151,137 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Ada | 51 | $5 | 1,783 | $82 | | | $20,355 |
| Adams | 17,745 | 1,739 | | | | | 12,241 |
| Benewah | | | | | | | 140 |
| Blaine | 107,174 | 10,503 | 14,772,065 | 679,515 | 24,144,083 | $1,158,916 | 2,711,107 |
| Boise | 4,765 | 467 | 129,674 | 5,965 | | | 1,009,194 |
| Bonner | 4,643 | 455 | 1,351,826 | 62,184 | 41,792 | 2,006 | 107,582 |
| Bonneville | | | | | | | 4,340 |
| Boundary | 3,418 | 335 | 585,891 | 26,951 | | | 37,553 |
| Butte | 806 | 79 | 61,259 | 2,817 | | | 20,953 |
| Camas | 1,796 | 176 | 8,130 | 374 | | | 16,722 |
| Canyon | | | | | | | 105 |
| Cassia | 41 | 4 | 304 | 14 | | | 80 |
| Clark | 1,439 | 141 | | | | | 143 |
| Clearwater | | | | | | | 38,683 |
| Custer | 39,592 | 3,880 | 1,932,022 | 88,873 | | | 225,646 |
| Elmore | | | | | | | 274,183 |
| Gem | 500 | 49 | 4,348 | 200 | | | 144,736 |
| Gooding | | | | | | | 280 |
| Idaho | 55,531 | 5,442 | 24,413 | 1,123 | | | 1,183,141 |
| Jerome | | | | | | | 9,321 |
| Kootenai | | | | | | | 70 |
| Latah | | | | | | | 1,925 |
| Lemhi | 256,214 | 25,109 | 767,304 | 35,296 | | | 331,326 |
| Lewis | | | | | | | 210 |
| Nez Perce | | | | | | | 2,531 |
| Owyhee | | | 978 | 45 | | | 303,084 |
| Power | | | | | | | 840 |
| Shoshone | 3,765,795 | 369,048 | 164,547,979 | 7,569,207 | 63,874,125 | 3,065,958 | 22,346,313 |
| Twin Falls | | | | | | | 2,977 |
| Valley | 3,786 | 371 | 132,935 | 6,115 | | | 196,940 |
| Washington | 14,704 | 1,441 | 33,109 | 1,523 | | | 25,382 |
| Total, 1937 | 4,278,000 | 419,244 | 184,354,000 | 8,480,284 | 88,060,000 | 4,226,880 | 29,028,103 |
| | 4,464,000 | 540,144 | 207,422,000 | 12,237,898 | 108,398,000 | 7,045,870 | 37,840,184 |

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*Gold and silver produced at lode mines in Idaho in 1938, by counties, in terms of recovered metals*

| County | Ore sold or treated | Gold | Silver | County | Ore sold or treated | Gold | Silver |
|---|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | | *Short tons* | *Fine ounces* | *Fine ounces* |
| Ada | 624 | 177 | 82 | Custer | 39,833 | 199 | 180,313 |
| Adams | 227 | 274 | 379 | Elmore | 17,808 | 5,925 | 39,368 |
| Blaine | 108,290 | 5,047 | 1,059,993 | Gem | 84 | 105 | 3,892 |
| Boise | 31,798 | 6,379 | 44,598 | Idaho | 143,318 | 15,580 | 33,957 |
| Bonner | 12,994 | 65 | 62,899 | Lemhi | 65,144 | 5,161 | 78,261 |
| Bonneville | 10 | 9 | | Owyhee | 11,767 | 870 | 44,386 |
| Boundary | 4,201 | 34 | 14,041 | Shoshone | 1,514,278 | 3,769 | 17,325,342 |
| Butte | 1,135 | 141 | 20,298 | Valley | 40,367 | 4,716 | 32,984 |
| Camas | 737 | 201 | 939 | Washington | 688 | 1 | 34,353 |
| Cassia | 8 | | 96 | | | | |
| Clark | 3 | | 3 | | 1,999,147 | 49,434 | 18,976,348 |
| Clearwater | 5,833 | 781 | 164 | Total, 1937 | 2,075,402 | 41,321 | 19,575,479 |

*Gold and silver produced at placer mines in Idaho in 1938, by counties, in fine ounces, in terms of recovered metals*

| County | Sluicing, and hydraulic and sluicing | | Drift mining | | Dragline dredges [1] | | Floating (bucket) dredges | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| Ada | 76 | 15 | | | 324 | 16 | | | 400 | 31 |
| Adams | 19 | 3 | | | | | | | 19 | 3 |
| Benewah | 4 | | | | | | | | 4 | |
| Blaine | 8 | | | | | | | | 8 | |
| Boise | 606 | 140 | 57 | 8 | 2,139 | 529 | 18,549 | 4,553 | 21,351 | 5,230 |
| Bonneville | 115 | | | | | | | | 115 | |
| Camas | 3 | 1 | | | | | 238 | 146 | 241 | 147 |
| Canyon | 3 | | | | | | | | 3 | |
| Clearwater | 241 | 47 | | | 79 | 18 | | | 320 | 65 |
| Custer | 100 | 193 | | | 162 | 104 | | | 262 | 297 |
| Elmore | 252 | 61 | | | 926 | 137 | | | 1,178 | 198 |
| Gem | 11 | 4 | | | 3,933 | 392 | | | 3,944 | 396 |
| Gooding | 8 | | | | | | | | 8 | |
| Idaho | 1,615 | 321 | 149 | 25 | 7,379 | 1,617 | 8,180 | 2,707 | 17,323 | 4,670 |
| Jerome | 266 | 17 | | | | | | | 266 | 17 |
| Kootenai | 2 | | | | | | | | 2 | |
| Latah | 55 | | | | | | | | 55 | |
| Lemhi | 1,127 | 113 | 5 | | | | | | 1,132 | 113 |
| Lewis | 6 | | | | | | | | 6 | |
| Nez Perce | 72 | 17 | | | | | | | 72 | 17 |
| Owyhee | 83 | 4 | | | 2,506 | 3,389 | 4,267 | 2,694 | 6,856 | 6,087 |
| Power | 24 | | | | | | | | 24 | |
| Shoshone | 91 | 13 | 193 | 24 | | | | | 284 | 37 |
| Twin Falls | 85 | 3 | | | | | | | 85 | 3 |
| Valley | 115 | 17 | 1 | | | | | | 116 | 17 |
| Washington | | | 5 | | | | | | 5 | |
| | 4,987 | 969 | 410 | 57 | [2] 17,448 | [2] 6,202 | [3] 31,234 | [3] 10,100 | 54,079 | 17,328 |
| Total, 1937 | 4,286 | 1,399 | 433 | 65 | 6,859 | 1,652 | 28,962 | 9,171 | 40,540 | 12,287 |

[1] Power-shovel excavators with floating washing plants or special amalgamators.
[2] Recovered from 2,713,000 cubic yards of gravel treated by 19 dragline dredges.
[3] Recovered from 6,693,700 cubic yards of gravel treated by 9 connected-bucket dredges.

## MINING INDUSTRY

The average sales prices of both lead and zinc dropped rapidly during the first half of 1938, and although prices strengthened somewhat during the latter half of the year the yearly averages were considerably lower than in 1937; lead was off 1.3 cents a pound and zinc 1.7 cents. These declines, combined with the reduction in the silver price to 64.6+ cents an ounce, resulted in curtailment in output of silver, lead, and zinc by virtually all the large mines in the Coeur

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d'Alene region. Production of zinc in Idaho decreased 19 percent in quantity and 40 percent in value; lead, 11 and 31 percent, respectively; and silver, 3 and 19 percent, respectively. The decreases in output of metals in the Coeur d'Alene region were offset in part by a large increase in output of zinc-lead ore from Blaine County and by increases in gold from both lode mines and placers.

## ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore sold or treated in Idaho in 1938, with content in terms of recovered metals*

| Source | Mines producing | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 189 | 283,204 | 40,305 | 130,287 | 250,190 | 242,496 | ---------- |
| Dry and siliceous gold-silver ore | 16 | 15,672 | 2,123 | 90,692 | 1,631 | 205,342 | ---------- |
| Dry and siliceous silver ore | 28 | 444,456 | 1,065 | 13,599,812 | 3,142,508 | 1,835,028 | ---------- |
| | [1] 232 | 743,332 | 43,493 | 13,820,791 | 3,394,329 | 2,282,866 | ---------- |
| Copper ore | 9 | 165 | 58 | 1,339 | 34,361 | 665 | ---------- |
| Lead ore | 55 | 272,904 | 831 | 1,449,666 | 221,385 | 42,665,859 | 643,000 |
| Zinc-lead ore | 23 | 982,746 | 5,052 | 3,704,552 | 627,925 | 139,404,610 | 87,417,000 |
| Total, lode mines | [1] 305 | 1,999,147 | 49,434 | 18,976,348 | 4,278,000 | 184,354,000 | 88,060,000 |
| Total, placers | 463 | ---------- | 54,079 | 17,328 | ---------- | ---------- | ---------- |
| Total, 1937 | 768 | 1,999,147 | 103,513 | 18,993,676 | 4,278,000 | 184,354,000 | 88,060,000 |
| | 1,088 | 2,075,402 | 81,861 | 19,587,766 | 4,464,000 | 207,422,000 | 108,398,000 |

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

## METALLURGIC INDUSTRY

Of the 1,999,147 tons of ore (including old tailings) produced in 1938 in Idaho, 186,163 tons (9 percent) were treated at amalgamation and cyanidation mills, 1,779,815 tons (89 percent) were treated at concentration plants, and 33,169 tons (2 percent) were shipped for smelting.

The ore treated at amalgamation and cyanidation mills comprised 12,490 tons treated at straight amalgamation plants, yielding 2,458 ounces of gold and 730 ounces of silver; 59,987 tons treated at combined amalgamation and concentration plants, yielding 11,001 ounces of gold and 5,581 ounces of silver in amalgamation bullion and 616 tons of concentrates; and 113,686 tons treated at straight cyanidation plants. The ore treated at the cyanidation plants contained 4,270 ounces of gold and 3,109 ounces of silver, indicating cyanide extractions of 67 percent of the gold and 60 percent of the silver; the plants used 106,676 pounds of sodium cyanide (91-percent grade), 13,808 pounds of zinc dust, and 600,725 pounds of lime.

The ore treated at concentration plants comprised 93,911 tons of gold ore, 13,105 tons of gold-silver ore, 437,366 tons of silver ore, 252,687 tons of lead ore, and 982,746 tons of zinc-lead ore.

Details of the treatment of all ores produced in Idaho in 1938 are given in the tables that follow.

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*Mine production of metals in Idaho in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore and old tailings amalgamated | 72,477 | 13,459 | 6,311 | | | |
| Ore and old tailings cyanided | 113,686 | 2,855 | 1,878 | | | |
| Concentrates smelted [1] | 260,462 | 26,030 | 18,099,795 | 4,086,156 | 170,775,538 | 88,060,000 |
| Ore and old tailings smelted | 33,169 | 7,090 | 868,364 | 191,844 | 13,578,462 | |
| Placer | | 54,079 | 17,328 | | | |
| | | 103,513 | 18,993,676 | 4,278,000 | 184,354,000 | 88,060,000 |
| Total, 1937 | | 81,861 | 19,587,766 | 4,464,000 | 207,422,000 | 108,398,000 |

[1] Includes zinc concentrates treated at electrolytic plants.

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Idaho in 1938, by types of mills and by counties, in terms of recovered metals*

AMALGAMATION MILLS

| County | Material treated | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Ada | 583 | 120 | 14 | 13 | 18 | 2 | 51 | |
| Blaine | 25 | 7 | 8 | | | | | |
| Boise | 11,806 | 1,976 | 553 | 16 | 137 | 666 | 191 | 534 |
| Bonneville | 10 | 9 | | | | | | |
| Camas | 10 | 11 | 3 | | | | | |
| Clearwater | 30 | 17 | 4 | | | | | |
| Elmore | 16,315 | 1,903 | 1,600 | 162 | 821 | 12,751 | | |
| Gem | 2 | 2 | 1 | | | | | |
| Idaho | 25,394 | 8,354 | 3,658 | 120 | 1,457 | 17,827 | 898 | 3,282 |
| Lemhi | 13,993 | 420 | 66 | 282 | 739 | 2,201 | 181,602 | 4,500 |
| Owyhee | 525 | 72 | 62 | 19 | 67 | 259 | | 826 |
| Shoshone | 20 | 19 | 3 | | | | | |
| Valley | 3,764 | 549 | 339 | 4 | 150 | 350 | | |
| | 72,477 | 13,459 | 6,311 | 616 | 3,389 | 34,056 | 182,742 | 9,142 |
| Total, 1937 | 65,673 | 14,348 | 5,768 | 255 | 2,161 | 28,491 | 111,478 | 3,339 |

CYANIDATION MILLS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Blaine | 1,400 | 138 | 535 | | | | | |
| Clearwater | 5,803 | 764 | 160 | | | | | |
| Idaho | 106,483 | 1,953 | 1,183 | | | | | |
| | 113,686 | 2,855 | 1,878 | | | | | |
| Total, 1937 | 79,383 | 6,897 | 2,709 | 44 | 110 | 94 | | |
| Grand total: 1938 | 186,163 | 16,314 | 8,189 | 616 | 3,389 | 34,056 | 182,742 | 9,142 |
| 1937 | 145,056 | 21,245 | 8,477 | 299 | 2,271 | 28,585 | 111,478 | 3,339 |

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*Mine production of metals from concentrating mills in Idaho in 1938, by counties, in terms of recovered metals*

| County | Ore and old tailings treated | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|
| | | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Blaine | 103,944 | 47,360 | 3,719 | 1,017,887 | 104,318 | 14,557,383 | 24,144,083 |
| Boise | 19,724 | 800 | 3,488 | 25,506 | 1,225 | 120,000 | ---------- |
| Bonner | 12,892 | 1,047 | 62 | 50,983 | 2,962 | 1,293,145 | 41,792 |
| Boundary | 4,200 | 439 | 30 | 14,040 | 3,418 | 585,891 | ---------- |
| Camas | 450 | 33 | 86 | 387 | 946 | 3,480 | ---------- |
| Custer | 39,004 | 1,359 | 53 | 124,676 | 17,703 | 1,691,808 | ---------- |
| Elmore | 3 | 1 | 3 | 1 | ---------- | ---------- | ---------- |
| Idaho | 11,313 | 482 | 3,637 | 10,361 | 54,633 | 20,892 | ---------- |
| Lemhi | 49,890 | 2,035 | 3,698 | 63,388 | 57,643 | 206,246 | ---------- |
| Owyhee | 11,143 | 91 | 673 | 36,343 | ---------- | 152 | ---------- |
| Shoshone | 1,491,009 | 203,979 | 3,646 | 16,698,737 | 3,657,362 | 152,263,529 | 63,874,125 |
| Valley | 36,243 | 2,220 | 3,546 | 23,430 | 3,204 | 23,870 | ---------- |
| Total, 1937 | 1,779,815 | 259,846 | 22,641 | 18,065,739 | 3,903,414 | 170,766,396 | 88,060,000 |
| | 1,894,447 | 294,654 | 12,856 | 18,550,344 | 4,018,221 | 192,001,069 | 108,398,000 |



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*Gross metal content of Idaho concentrates produced in 1938, by classes of concentrates*

| Class of concentrates | Concentrates produced | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 4,170 | 14,248 | 68,674 | 9,164 | 163,487 | |
| Dry gold-silver | 130 | 819 | 37,127 | | 163 | |
| Dry silver | 1,368 | 50 | 68,811 | 78,623 | 164,217 | |
| Copper | 12,192 | 2,914 | 11,377,193 | 3,129,570 | 721,575 | |
| Lead | 137,973 | 4,641 | 4,310,708 | 657,108 | 170,978,162 | 14,049,147 |
| Lead-copper | 4,009 | 476 | 1,837,906 | 843,866 | 815,880 | |
| Zinc | 89,538 | 970 | 366,501 | 328,728 | 4,849,380 | 96,798,500 |
| Iron (from zinc-lead ore) | 11,082 | 1,912 | 32,875 | 17,700 | 363,100 | 619,400 |
| Total, 1937 | 260,462 | 26,030 | 18,099,795 | 5,064,759 | 178,055,964 | 111,467,047 |
| | 294,953 | 15,127 | 18,578,929 | 5,163,988 | 200,600,901 | 139,185,509 |

*Mine production of metals from Idaho concentrates in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ada | 13 | 18 | 2 | 51 | | |
| Blaine | 47,360 | 3,719 | 1,017,887 | 104,318 | 14,557,383 | 24,144,083 |
| Boise | 816 | 3,625 | 26,172 | 1,416 | 120,534 | |
| Bonner | 1,047 | 62 | 50,983 | 2,962 | 1,293,145 | 41,792 |
| Boundary | 439 | 30 | 14,040 | 3,418 | 585,891 | |
| Camas | 33 | 86 | 387 | 946 | 3,480 | |
| Custer | 1,359 | 53 | 124,676 | 17,703 | 1,691,808 | |
| Elmore | 163 | 824 | 12,752 | | | |
| Idaho | 602 | 5,094 | 28,188 | 55,531 | 24,174 | |
| Lemhi | 2,317 | 4,437 | 65,589 | 239,245 | 210,746 | |
| Owyhee | 110 | 740 | 36,602 | | 978 | |
| Shoshone | 203,979 | 3,646 | 16,698,737 | 3,657,362 | 152,263,529 | 63,874,125 |
| Valley | 2,224 | 3,696 | 23,780 | 3,204 | 23,870 | |
| Total, 1937 | 260,462 | 26,030 | 18,099,795 | 4,086,156 | 170,775,538 | 88,060,000 |
| | 294,953 | 15,127 | 18,578,929 | 4,129,699 | 192,004,408 | 108,398,000 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 4,170 | 14,248 | 68,674 | 6,989 | 153,523 | |
| Dry gold-silver | 130 | 819 | 37,127 | | 152 | |
| Dry silver | 1,368 | 50 | 68,811 | 55,115 | 157,664 | |
| Copper | 12,192 | 2,914 | 11,377,193 | 2,554,402 | 691,209 | |
| Lead | 137,973 | 4,641 | 4,310,708 | 531,971 | 164,143,095 | |
| Lead-copper | 4,009 | 476 | 1,837,906 | 685,533 | 782,812 | |
| Zinc | 89,538 | 970 | 366,501 | 235,049 | 4,574,790 | 88,060,000 |
| Iron (from zinc-lead ore) | 11,082 | 1,912 | 32,875 | 17,097 | 272,293 | |
| | 260,462 | 26,030 | 18,099,795 | 4,086,156 | 170,775,538 | 88,060,000 |

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*Gross metal content of Idaho crude ore and old tailings shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore and old tailings smelted | Gross metal content | | | |
|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 3,160 | 4,859 | 30,407 | 6,990 | 37,542 |
| Dry and siliceous gold-silver | 3,574 | 1,568 | 82,313 | 3,112 | 246,428 |
| Dry and siliceous silver | 8,083 | 33 | 310,774 | 101,072 | 226,358 |
| Copper | 165 | 58 | 1,339 | 38,629 | 709 |
| Lead | 18,187 | 572 | 443,531 | 86,059 | 13,677,360 |
| | 33,169 | 7,090 | 868,364 | 235,862 | 14,188,397 |
| Total, 1937 | 35,899 | 4,949 | 988,073 | 394,740 | 16,081,965 |

*Mine production of metals from Idaho crude ore and old tailings shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore and old tailings | Gold | Silver | Copper | Lead |
|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Ada | 41 | 39 | 66 | | 1,783 |
| Adams | 227 | 274 | 379 | 17,745 | |
| Blaine | 2,921 | 1,183 | 41,563 | 2,856 | 214,682 |
| Boise | 268 | 778 | 17,873 | 3,349 | 9,140 |
| Bonner | 102 | 3 | 11,916 | 1,681 | 58,681 |
| Boundary | 1 | 4 | 1 | | |
| Butte | 1,135 | 141 | 20,298 | 806 | 61,239 |
| Camas | 277 | 104 | 549 | 850 | 4,650 |
| Cassia | 8 | | 96 | 41 | 304 |
| Clark | 3 | | 3 | 1,439 | |
| Custer | 829 | 146 | 55,637 | 21,889 | 240,214 |
| Elmore | 1,490 | 3,198 | 25,016 | | |
| Gem | 82 | 103 | 3,891 | 500 | 4,348 |
| Idaho | 128 | 179 | 928 | | 239 |
| Lemhi | 1,261 | 304 | 12,606 | 16,969 | 556,558 |
| Owyhee | 99 | 58 | 7,722 | | |
| Shoshone | 23,249 | 104 | 626,602 | 108,433 | 12,284,450 |
| Valley | 360 | 471 | 8,865 | 582 | 109,065 |
| Washington | 688 | 1 | 34,353 | 14,704 | 33,109 |
| | 33,169 | 7,090 | 868,364 | 191,844 | 13,578,462 |
| Total, 1937 | 35,899 | 4,949 | 988,073 | 334,301 | 15,417,592 |

BY CLASSES OF ORE

| | | | | | |
|---|---|---|---|---|---|
| Dry and siliceous gold | 3,160 | 4,859 | 30,407 | 5,869 | 32,254 |
| Dry and siliceous gold-silver | 3,574 | 1,568 | 82,313 | 2,593 | 198,429 |
| Dry and siliceous silver | 8,083 | 33 | 310,774 | 81,009 | 214,527 |
| Copper | 165 | 58 | 1,339 | 34,361 | 665 |
| Lead | 18,187 | 572 | 443,531 | 68,012 | 13,132,587 |
| | 33,169 | 7,090 | 868,364 | 191,844 | 13,578,462 |

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in Idaho in 1938, by counties and districts, in terms of recovered metals*

| County and district | Mines producing | | Ore | Gold | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | | | | | |
| Ada County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Black Hornet | 2 | | 585 | 141 | | 17 | 51 | | | $4,951 |
| Blacks Creek | 1 | | 39 | 36 | | 65 | | 1,783 | | 1,384 |
| Highland (Boise River) | | 4 | | | 56 | 14 | | | | 1,969 |
| Snake River | | 3 | | | 335 | 17 | | | | 11,736 |
| Adams County: | | | | | | | | | | |
| Rock Flat | | 1 | | | 14 | 3 | | | | 492 |
| Seven Devils | 5 | | 227 | 274 | | 379 | 17,745 | | | 11,574 |
| Blaine County: | | | | | | | | | | |
| Mineral Hill | 16 | | 1,864 | 576 | | 3,813 | 1,939 | 24,239 | 4,083 | 24,126 |
| Sawtooth | 2 | | 145 | 163 | | 1,239 | 133 | 4,826 | | 6,741 |
| Warm Springs | 5 | 2 | 106,131 | 4,308 | 8 | 1,054,746 | 104,959 | 14,740,543 | 24,140,000 | 2,679,987 |
| Boise County: | | | | | | | | | | |
| Boise Basin | 23 | 68 | 30,792 | 5,962 | 21,319 | 46,694 | 1,908 | 127,891 | | 991,091 |
| Eight Mile Creek | 1 | | 20 | 33 | | 17 | | | | 1,166 |
| Grimes Pass | 4 | | 719 | 230 | | 1,304 | 2,704 | 1,674 | | 9,235 |
| North Fork | 1 | | 43 | | | 1,646 | 133 | 109 | | 1,082 |
| South Fork of Payette River | | 3 | | | 19 | | | | | 665 |
| Summit Flat | 4 | | 202 | 142 | | 96 | | | | 5,032 |
| West View | 1 | | 19 | 9 | | 68 | 20 | | | 361 |
| Bonner County: | | | | | | | | | | |
| Lakeview | 1 | | 304 | 56 | | 4,291 | 2,847 | 55,696 | 41,792 | 9,581 |
| Pend d'Oreille | 8 | | 12,690 | 9 | | 58,608 | 1,796 | 1,296,130 | | 98,001 |
| Bonneville County: Mt. Pisgah | 1 | 4 | 10 | 9 | 115 | | | | | 4,340 |
| Boundary County: | | | | | | | | | | |
| Moyie Yahk | 2 | | 201 | 34 | | 212 | 71 | 3,848 | | 1,511 |
| Port Hill | 1 | | 4,000 | | | 13,829 | 3,347 | 582,043 | | 36,042 |
| Butte County: | | | | | | | | | | |
| Dome | 1 | | 98 | 1 | | 283 | 92 | 60,826 | | 3,025 |
| Lava Creek | 2 | | 1,037 | 140 | | 20,015 | 714 | 413 | | 17,928 |
| Camas County: | | | | | | | | | | |
| Little Smoky | 4 | 2 | 724 | 156 | 241 | 1,069 | 1,796 | 8,130 | | 15,136 |
| Skeleton Creek | 1 | | 13 | 45 | | 17 | | | | 1,586 |
| Clearwater County: | | | | | | | | | | |
| Burnt Creek | | 4 | | | 18 | | | | | 630 |
| Clearwater River | | 4 | | | 15 | | | | | 525 |
| Moose Creek and Independence Creek | | 7 | | | 35 | 3 | | | | 1,227 |
| North Fork of Clearwater River | | 5 | | | 34 | 14 | | | | 1,199 |
| Pierce | 2 | 21 | 5,833 | 781 | 216 | 212 | | | | 35,032 |

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|---|---|---|---|---|---|---|---|---|---|---|
| Custer County: | | | | | | | | | | |
| Alder Creek | 4 | | 184 | 2 | | 3,270 | 398 | 100,696 | | 6,855 |
| Bayhorse | 5 | | 39,569 | 45 | | 172,048 | 36,469 | 1,830,065 | | 200,555 |
| Copper Basin | 1 | | 37 | | | 362 | 2,439 | | | 473 |
| Rough Creek | | 1 | | | 26 | 3 | | | | 912 |
| Stanley and Stanley Basin | 1 | 4 | 2 | 6 | 192 | 130 | | | | 7,014 |
| Yankee Fork | 8 | 4 | 41 | 146 | 39 | 4,797 | 286 | 1,261 | | 9,662 |
| Elmore County: | | | | | | | | | | |
| Bear Creek | 8 | 5 | 56 | 86 | 306 | 308 | | | | 13,919 |
| Boise River | | 6 | | | 117 | 34 | | | | 4,117 |
| Middle Boise | 4 | 12 | 17,691 | 5,820 | 69 | 39,173 | | | | 231,439 |
| Neal | 2 | | 29 | 11 | | 3 | | | | 387 |
| Snake River | | 7 | | | 684 | 34 | | | | 23,962 |
| Gem County: West View | 4 | 5 | 84 | 105 | 3,944 | 4,288 | 500 | 4,348 | | 144,736 |
| Idaho County: | | | | | | | | | | |
| American, Bully, and Castle Creeks | | 3 | | | 12 | | | | | 420 |
| Camp Howard | | 8 | | | 617 | 116 | | | | 21,670 |
| Clearwater River | | 2 | | | 13 | | | | | 455 |
| Dixie | 11 | 14 | 1,475 | 336 | 148 | 297 | | | | 17,132 |
| Elk City | 8 | 16 | 251 | 118 | 1,798 | 393 | | | | 67,314 |
| Florence | 4 | 17 | 110 | 20 | 223 | 113 | | | | 8,578 |
| Lower Salmon River | | 5 | | | 27 | 3 | | | | 947 |
| Maggie and Pete King Creeks | 2 | 2 | 6 | 5 | 10 | 795 | | | | 1,039 |
| Marshall Lake | 3 | 9 | 10,438 | 5,869 | 222 | 19,308 | 775 | 2,304 | | 225,849 |
| Newsome | | 2 | | | 4,743 | 1,106 | | | | 166,720 |
| Orogrande | 4 | 5 | 106,020 | 1,937 | 397 | 1,171 | | 239 | | 82,458 |
| Ramey Ridge | 3 | | 5,742 | 2,517 | | 9,139 | 53,000 | 11,109 | | 99,708 |
| Robbins | 4 | 1 | 4,971 | 1,031 | 2 | 1,089 | 1,633 | 9,783 | | 37,469 |
| Salmon River (Riggins and French Creek) | | 4 | | | 229 | 48 | | | | 8,046 |
| Salmon River (near Shoup) | | 4 | | | 36 | 14 | | | | 1,269 |
| Simpson | | 9 | | | 119 | 17 | | | | 4,176 |
| Snake River | | 4 | | | 30 | 3 | | | | 1,052 |
| Ten Mile | 11 | 8 | 13,576 | 3,102 | 785 | 1,635 | 123 | 674 | | 137,145 |
| Warren | 13 | 11 | 729 | 645 | 7,889 | 3,380 | | 304 | | 300,889 |
| Jerome County: Snake River | | 11 | | | 266 | 17 | | | | 9,321 |
| Latah County: | | | | | | | | | | |
| Gold Creek | | 3 | | | 15 | | | | | 525 |
| Hoodoo | | 4 | | | 23 | | | | | 805 |
| Moscow Mountain | | 4 | | | 17 | | | | | 595 |
| Lemhi County: | | | | | | | | | | |
| Blue Wing | 1 | | 26,823 | 9 | | 59,335 | 55,000 | 155,804 | | 51,230 |
| Boyle Creek and Carmen Creek | 1 | | 2,778 | 89 | | 1,403 | 622 | 7,326 | | 4,420 |
| Eureka | 4 | 4 | 389 | 236 | 28 | 198 | 10,510 | | | 10,398 |
| Gibbonsville | 9 | 11 | 1,513 | 668 | 697 | 492 | 408 | 870 | | 48,173 |
| Indian Creek | 1 | | 401 | 60 | | 34 | 194 | | | 2,141 |
| Junction | 1 | | 20 | | | 345 | | 12,283 | | 788 |
| Kirtley Creek | | 1 | | | 65 | 14 | | | | 2,284 |
| McDevitt | 1 | | 10,075 | 401 | | 1,850 | 181,602 | | | 33,028 |
| Mackinaw | 3 | 23 | 76 | 67 | 228 | 280 | 82 | 8,913 | | 10,924 |
| Mineral Hill | 3 | 6 | 10,376 | 2,198 | 40 | 1,570 | | 14,891 | | 80,030 |
| Pratt Creek and Sandy Creek | 4 | | 11,104 | 1,131 | | 1,055 | 2,796 | 31,652 | | 41,997 |
| Salmon River | | 8 | | | 70 | 17 | | | | 2,461 |

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*Mine production of gold, silver, copper, lead, and zinc in Idaho in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore | Gold | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | | | | | |
| Lemhi County—Continued. | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Texas | | | | | | | | | | |
| Yellow Jacket | 5 | | 843 | 31 | | 11,300 | 4,173 | 534,761 | | $33,398 |
| Nez Perce County: | 4 | | 742 | 269 | | 297 | 827 | 804 | | 9,725 |
| Salmon River | | 2 | | | 17 | 3 | | | | 597 |
| Snake River | | 4 | | | 55 | 14 | | | | 1,934 |
| Owyhee County: | | | | | | | | | | |
| Carson | 16 | 4 | 11,239 | 759 | 6,753 | 44,414 | | 152 | | 291,639 |
| Castle Creek | 4 | | 520 | 100 | | 6,042 | | 826 | | 7,444 |
| Snake River | | 8 | | | 103 | 3 | | | | 3,607 |
| Steele | 1 | | 8 | 11 | | 14 | | | | 394 |
| Power County: Snake River | | 4 | | | 24 | | | | | 840 |
| Shoshone County: | | | | | | | | | | |
| Beaver | 3 | 6 | 3,936 | 6 | 13 | 3,578 | 245 | 235,609 | 434,604 | 34,701 |
| Coeur d'Alene | 1 | 5 | 20 | 19 | 72 | 20 | | | | 3,198 |
| Eagle | 1 | | 8,016 | 6 | | 6,367 | | 1,543,000 | 207,417 | 85,260 |
| Evolution | 4 | | 387,410 | 821 | | 12,952,662 | 2,920,663 | 1,159,674 | | 8,741,743 |
| Hunter | 9 | | 348,560 | 286 | | 938,998 | 169,398 | 44,929,152 | 32,213,917 | 4,246,649 |
| Lelande | 8 | | 275,521 | 416 | | 1,329,160 | 249,745 | 46,376,326 | 7,102,333 | 3,372,513 |
| Placer Center | 5 | | 14,586 | 20 | | 82,269 | 18,000 | 1,980,261 | 750,000 | 182,740 |
| St. Joe | | 4 | | | 41 | 3 | | | | 1,437 |
| Summit | 4 | 5 | 6,033 | 1,323 | 158 | 1,038 | 1,265 | 74,391 | 14,250 | 56,736 |
| Yreka | 8 | | 470,196 | 872 | | 2,011,234 | 406,479 | 68,249,566 | 23,151,604 | 5,621,336 |
| Twin Falls County: Snake River | | 6 | | | 85 | 3 | | | | 2,977 |
| Valley County: | | | | | | | | | | |
| Big Creek | | 6 | | | 17 | 3 | | | | 597 |
| Deadwood Basin | 3 | 3 | 439 | 58 | 7 | 5,807 | 1,500 | 23,870 | | 7,274 |
| Lake City | | 3 | | | 80 | 14 | | | | 2,809 |
| Pistol Creek | 1 | | 348 | 451 | | 8,814 | 582 | 109,065 | | 26,557 |
| Thunder Mountain | 2 | 2 | 3,700 | 678 | 8 | 676 | | | | 24,447 |
| Yellow Pine | 1 | | 35,880 | 3,529 | | 17,687 | 1,704 | | | 135,116 |
| Washington County: Washington | 1 | | 688 | 1 | | 34,353 | 14,704 | 33,109 | | 25,207 |
| Other counties and districts [1] | 8 | 30 | 200 | 13 | 95 | 495 | 1,623 | 2,761 | | 4,386 |
| Total Idaho | 305 | 463 | 1,999,147 | 49,434 | 54,079 | 18,993,676 | 4,278,000 | 184,354,000 | 88,060,000 | 29,028,103 |

[1] Includes counties and districts with production valued at less than $350.

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### ADA COUNTY

The metal output of Ada County increased slightly in 1938; most of it was gold recovered from the New Deal & Hot Shot and Gold Flour placers on Snake River near Grand View and from gold ore treated by amalgamation and concentration at the Adelmann Bros. mine in the Black Hornet district. Placer operations were reported also in the Boise and Highland districts, and gold ore was shipped for smelting from a property on Blacks Creek.

### ADAMS COUNTY

The value of the metal output of Adams County decreased from $149,869 in 1937 to $12,241 in 1938 owing to suspension of operations late in 1937 at the 25-ton cyanidation plant at the Placer Basin mine in the Seven Devils district; the Placer Basin Co. worked the mine in 1937 but ceased operations at the end of the year and dismantled the cyanide plant. The mine was operated 4 months in 1938, and 4 cars of gold ore were shipped to a smelter. The remainder of the county output in 1938 was chiefly copper ore from the River Queen, Lockwood, and Helena properties in the Seven Devils district.

### BLAINE COUNTY

The value of the metal output of Blaine County increased from $1,842,899 in 1937 to $2,711,107 in 1938, owing almost entirely to increased output of zinc-lead ore from the Triumph and North Star mines in the Warm Springs district operated by Snyder Mines, Inc. In 1938 the company shipped 103,746 tons of zinc-lead ore to flotation plants at Bauer and Tooele, Utah, compared with about 68,000 tons in 1937; in addition, 2,380 tons of siliceous ore from the Triumph mine were shipped in 1938 for smelting. Aside from the four chief districts in the Coeur d'Alene region, the Warm Springs district was by far the most important producing area in Idaho. The Triumph mine ranked second in output of zinc in Idaho in 1938, fourth in lead, and sixth in silver. Other producers in Blaine County in 1938 included the Jupiter & Garfield property in the Little Wood River district; the Treasure Vault, Bellevue, Red Elephant, Gold Bottom, Red Leaf, Happy Day, Daisy, Champlain, and Red Rock mines in the Mineral Hill district; and the Vienna mine in the Sawtooth district.

### BOISE COUNTY

*Boise Basin district (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).*—The Boise Basin district continued in 1938 to be the chief gold-producing area in Idaho. Four floating bucket dredges treated 4,236,665 cubic yards of gravel in 1938 and recovered 18,549 ounces of gold, compared with 17,438 ounces in 1937. The Fisher-Baumhoff Co., which operated two bucket dredges (one equipped with seventy 2½-cubic foot buckets and the other with eighty 6-cubic foot buckets) near Centerville, was again the largest producer of gold in the State. Other large producers included the Moores Creek Dredging Co. operating a dredge equipped with seventy-two 7½-cubic foot buckets at Idaho City, the Grimes Co. operating a dredge equipped with seventy-two 3½-cubic foot buckets at Pioneerville, and the Lord & Bishop Co.

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operating a 3-cubic yard dragline and floating washing plant on Fall Creek. Considerable gold was recovered by hydraulic mining at the Leary-Brogan, Gold Hill, Packer, and Morning Star properties. The lode output of the district in 1938 was chiefly gold ore from the Mayflower and Gold Hill & Iowa properties. The Texas-Owyhee Mining & Development Co. operated the Mayflower mine near Placerville continuously and treated 19,712 tons of gold ore by flotation concentration. Talache Mines, Inc., operated the Gold Hill & Iowa mine the first 5 months of the year and treated 9,985 tons of gold ore by amalgamation, a decided decrease from the 31,563 tons treated in 1937; the mine was closed in May 1938 and the staff transferred to the company mine at Atlanta, Elmore County. The Come Back Mining Co. operated its mine at Pioneerville throughout 1938 and shipped high-grade gold-silver ore to a smelter. Most of the remainder of the district lode output was gold ore from the Hay Fork, Mountain Chief, Enterprise-Baby, and Mascot mines. Other producing lode mines in Boise County in 1938 included the Birthday mine on Eight Mile Creek; the Grandview, Homestake, Koon Dog, and K. C. mines near Grimes Pass; the Packer John property in the North Fork district; the Golden Cycle and Jessie mines in the Summit Flat district; and the Comeback mine in the West View district. The marked decrease in output from the Summit Flat district was due to suspension of operations by the Golden Cycle Mining Corporation late in 1937.

### BONNER COUNTY

Most of the output from Bonner County in 1938 was lead-silver ore, concentrated by flotation, from the Hope (Elsie K.) and Whitedelf properties in the Pend d'Oreille district. The output of ore from the Hope mine was less than half that in 1937, but the output from the Whitedelf increased. Rich silver ore from the Brown Bear, Katherine, Nameloc, and Talache mines, all also in the Pend d'Oreille district, was shipped to a smelter. The output from the Lakeview district decreased decidedly as the Keep Cool mill was not operated; the entire output was mill cleanings from former operations.

### BONNEVILLE COUNTY

The metal output of Bonneville County in 1938 was chiefly placer gold recovered by hydraulic and sluicing operations at the McCoy Creek, Rosanna, and James properties in the Mt. Pisgah district.

### BOUNDARY COUNTY

Virtually all the output of Boundary County in 1938 was lead-silver ore from the Idaho Continental mine in the Port Hill district; several thousand tons of ore were treated in a 50-ton flotation plant.

### BUTTE COUNTY

The output from Butte County in 1938 was crude ore shipped for smelting and comprised silver ore from the Hornsilver and Hub mines in the Lava Creek district and lead ore from the Great Western mine in the Dome district.

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### CAMAS COUNTY

The increase in output of gold in Camas County in 1938 resulted from operation by the Baumhoff-Fisher Co. of a bucket dredge, equipped with sixty 4-cubic foot buckets, on Little Smoky Creek, and from production of gold ore at the Five Points mine north of Fairfield in the Little Smoky district.

### CLEARWATER COUNTY

The output of gold from Clearwater County decreased 1,098 ounces in 1938 owing to suspension of operations at the bucket dredge (64 buckets of 4 cubic feet capacity) on Rhodes Creek, operated in 1937 by Gold Dredging, Inc., and at the dragline and washing plant on Quartz Creek, operated in 1937 by Jett-Ross Mines, Inc. The chief production in the county in 1938 was gold ore from the Silver Creek mine in the Pierce district, where the Silver Creek Gold Mining Co. completed a 50-ton cyanide plant and treated 5,803 tons of gold ore during the latter half of the year. The largest producer of placer gold in the county was the Gold Creek Placer Co., operating a dragline dredge on Orofino Creek in the Pierce district; the dredge operated only a few months.

### CUSTER COUNTY

In 1938, as usual, the Bayhorse district was the chief producing area in Custer County, but the value of the district metal output decreased $84,648 from 1937 owing to the decrease in silver from the Ramshorn property that more than offset an increase in silver from the Clayton mine. The Clayton mine and 100-ton flotation mill were operated the entire year by Clayton Silver Mines, and about 39,000 tons of lead ore were milled compared with 28,700 tons in 1937; lead concentrates rich in silver were shipped to Utah for smelting. Silver in crude ore shipped from the Ramshorn mine for smelting decreased nearly 61,000 ounces in 1938. Other producing lode mines in Custer County in 1938 included the White Knob, Bluebird, Ausich, and Horseshoe in the Alder Creek district; the Copper Basin in the Copper Basin district; the Homestake near Stanley; and the Snowdrift, Peak, New Light, and Sunbeam in the Yankee Fork district. Most of the placer output of the county came from Stanley Creek Placers near Stanley and the Gold Bar property in the Yankee Fork district.

### ELMORE COUNTY

The value of the metal output from the Middle Boise (Atlanta) district increased from $94,546 in 1937 to $231,439 in 1938. Virtually the entire production came from two properties—the Boise-Rochester mine operated by Talache Mines, Inc., and the Atlanta property operated by the Last Chance Mining Co. Each company treated about 8,000 tons of gold ore by amalgamation and concentration, and each shipped several hundred tons of rich gold ore for smelting. Other producing lode mines in Elmore County in 1938 included the Hunter, Empire, and Big Water in the Bear Creek district; the Homestake and Flat Creek in the Neal district; and the Elk Horn at Pine Grove. The Feather River Placer Mining Co. installed experimental equipment at a placer in the Bear Creek district and treated 21,000 cubic yards of gravel. The Northwest Gold Mining

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Co. treated 56,000 cubic yards of gravel from the Rose placer on Snake River near King Hill; the company operated a gas-powered shovel and a special screening and washing plant.

### GEM COUNTY

Production of gold in Gem County increased from 759 ounces in 1937 to 4,049 ounces in 1938. Ralph Davis, Inc., the chief producer, operated a dragline and floating washing plant at the Gatfield & Montour property in the West View district. Nearly all the output from lode mines was high-grade gold-silver ore from the Lulu and Black Rock claims.

### IDAHO COUNTY

*Camp Howard (Salmon River) district (White Bird).*—Gold recovered from placer operations in the Camp Howard district increased considerably in 1938. Most of it came from a dragline operation at the Large Bar; other producers included the Pine Bar, Klondyke, Horseshoe Bend Bar, and Olney placers.

*Dixie district.*—The ¾-cubic-yard dragline dredge at Dixie Placers was idle in 1938, resulting in a decrease in gold production in the Dixie district. Most of the district output was gold ore from the Mammoth mine, concentrated by flotation, and placer gold recovered by dragline dredges at the Salmon River Placer and Alpha properties.

*Elk City district.*—Production of gold in the Elk City district increased more than 1,000 ounces in 1938 owing to operation of a 1½-cubic-yard dragline and washer at the Marr-Witter property by the American River Mining Co. The company was organized early in the year and became a large producer of gold. Other fairly large producers of placer gold were the Little Million, Columbus, Deadwood, and Gold Hill properties. The Mount Vernon Co. operated its dredge, equipped with sixty-six 2-cubic-foot buckets, a short time at the Deadwood claim and then moved it to a property on upper Crooked River in the Orogrande district. The chief producers of lode gold were the Grangeville and Madre d'Oro mines.

*Florence district.*—Nearly the entire output of the Florence district in 1938 was placer gold; the largest producer was the Meadow Creek claim, operated by a dragline dredge.

*Marshall Lake district (Burgdorf).*—The most important metal production in the Marshall Lake district in 1938 was gold recovered from gold ore at the Golden Anchor mine. The Golden Anchor Mining Co. operated the mine the entire year and treated 10,432 tons of ore in a 50-ton amalgamation and flotation plant; it was the largest producer of lode gold in the State, but its output was less than in 1937. Placer operators in the district recovered 222 fine ounces of gold in 1938; the chief producers were the Laughing Water, Idaho Klondike, Golden Rule, and Mary Jane claims.

*Newsome district.*—The output of gold in the Newsome district was 4,743 ounces in 1938, compared with 832 ounces in 1937. The large gain resulted from steady operation of the dragline and washing plant on Newsome Creek by Ferris & Marchbank (Newsome Creek Mining Co.); the dredge treated 634,933 cubic yards of gravel from April 5 to November 30 and ranked fifth in the State as a gold producer.

*Orogrande district.*—Production of gold from lode mines in the Orogrande district decreased in 1938 but that from placers increased.

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The Orogrande-Frisco Gold Mines, Inc., continued to be the largest producer of gold in the district; it treated 105,983 tons of low-grade gold ore in a 500-ton cyanide plant and recovered 1,917 fine ounces of gold and 1,076 fine ounces of silver. The district output of placer gold (397 ounces) was recovered chiefly by bucket dredging by the Mount Vernon Mining Co. (capacity of dredge given under Elk City district) and sluicing operations at the Baker Gulch property.

*Ramey Ridge district.*—The value of the metal output of the Ramey Ridge district increased to $99,708 in 1938 owing to the large gain in output of gold ore from the Snow Shoe mine north of Big Creek. The Pierce Metals Development Co. operated the mine throughout the year and treated 5,238 tons of ore in a 25-ton concentration plant; the entire plant was destroyed by fire in January 1939. Nearly all the remainder of the district output was gold ore from the Hand property, treated by amalgamation.

*Robbins (Buffalo Hump) district.*—The operation of the St. Louis mine by lessees resulted in a large increase in production of gold in the Robbins district in 1938; several thousand tons of gold ore from the mine were treated by concentration at a custom mill at Elk City. The remainder of the district output was chiefly old tailings (gold) from the Jumbo dump, treated by cyanidation.

*Salmon River (Riggins and French Creek) district.*—Placer operations at Riggins and French Creek recovered 229 fine ounces of gold and 48 fine ounces of silver in 1938; the chief producer was the Morland Gold Corporation, operating the Shorts Bar at Riggins with hydraulic and sluicing equipment.

*Ten Mile district (Golden).*—The value of the metal output of the Ten Mile district increased from $56,001 in 1937 to $137,145 in 1938 owing to gains in output of gold from the Lone Pine and Blackbird lode mines and the Lena B-Komo placer. The Lone Pine mine was operated throughout the year and was again the largest producer in the district; about 8,000 tons of ore were treated by amalgamation and concentration. The Clearwater Mining Co. was organized early in the year to operate the Blackbird property, and from February 1 to December 22 about 5,000 tons of ore were treated by amalgamation and concentration. Dragline dredging operations at the Lena B-Komo placer were conducted from April 20 to August 7 by the Western Gold Corporation; the company treated 186,494 cubic yards of gravel and recovered 698 fine ounces of gold and 136 fine ounces of silver. The 2-cubic yard dragline and washing plant were moved in August to a property in Oregon. Most of the remainder of the district output was gold ore from the Shamrock, Red Wing, and Gold King mines.

*Warren district.*—The value of the metal output of the Warren district increased from $248,027 in 1937 to $300,889 in 1938; the chief production was placer gold recovered by two bucket dredges. The Warren Dredging Co. operated its dredge, equipped with seventy-five 3½-cubic foot buckets, nearly all of 1938 and treated 1,015,000 cubic yards of gravel; the company ranked fourth in Idaho as a gold producer. A dredge of the same size as the Warren dredge was operated by the Baumhoff-Fisher Co.; it treated 608,000 cubic yards of gravel from April 20 to November 11 and recovered 2,022 fine ounces of gold and 722 fine ounces of silver. Production of gold from lode mines in the district came chiefly from the Rescue and Little Giant (Unity) properties.

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### JEROME COUNTY

The metal output of Jerome County in 1938 was placer gold and silver recovered by various operators along the banks of Snake River near Jerome and Murtaugh.

### LEMHI COUNTY

*Blue Wing district.*—In 1938, as in 1937, the entire output of the Blue Wing district was tungsten ore, containing appreciable silver, copper, and lead, from the Ima mine at May. The capacity of the mill was enlarged to treat 150 tons of ore a day, and a new Diesel compressor plant was installed; 26,823 tons of ore were treated by flotation and magnetic separation.

*Boyle and Carmen Creeks district.*—The Gibbonsville Mining & Exploration Co. constructed a 150-ton flotation plant at the Silver Star mine in 1938 and treated 2,778 tons of low-grade gold-silver ore.

*Eldorado district.*—No metal was produced in the Eldorado district in 1938, as the Ranger property, a large producer of gold in 1937, was not productive.

*Eureka district.*—Most of the output from the Eureka district in 1938 was gold ore from the Queen of the Hills mine, treated by amalgamation, and gold ore from the Starlight mine, shipped for smelting.

*Gibbonsville district.*—Most of the output from lode mines in the Gibbonsville district in 1938 was gold ore from the Twin Brothers mine, treated by concentration; nearly all the placer production was recovered by hydraulic and sluicing operations at the Sundown property by North Fork Placers.

*McDevitt district.*—All the output of the McDevitt district in 1938 was gold ore and old tailings from the Copper Queen property, treated by concentration; the Tendoy Copper Queen Syndicate operated the mine throughout the year and in December completed the construction of a new 50-ton flotation plant.

*Mackinaw district.*—Virtually the entire output from lode mines in the Mackinaw district in 1938 was gold ore from the Shoo Fly mine, treated by amalgamation and concentration. The chief placer producers were the K. G. W., Beaver Creek, and Richardson claims.

*Mineral Hill district.*—Production of gold in the Mineral Hill district was 2,238 ounces in 1938 compared with 245 ounces in 1937. The large gain was due to operation of the Grunter mine and to the increase in output of gold ore from the Gold Hill mine, both at Shoup. The Grunter mine was acquired in January by Gold Producers, Inc., and 6,725 tons of gold ore were treated during the year in the 50-ton flotation mill, formerly used to treat ore from mines at Gibbonsville but moved to Shoup in August; the mine was the largest producer of gold in Lemhi County in 1938. The Gold Hill mine and 100-ton flotation mill were leased in July by I. D. Theriault, and 3,650 tons of gold ore were treated by amalgamation and concentration.

*Pratt and Sandy Creeks district.*—The large increase in output of gold ore from the Goldstone mine on Pratt Creek resulted in a gain in the district gold production in 1938. The mine was operated the entire year by the Goldstone Mining Co., and several thousand tons of ore were treated by concentration. Gold ore was produced also from the Gem, Mendota, and Gray Eagle mines.

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*Texas district.*—The value of the metal output of the Texas district decreased from $111,373 in 1937 to $33,398 in 1938 owing to the decline in shipments of lead-silver ore from the Silver Moon and Latest Out mines.

*Yellow Jacket district.*—Most of the output from the Yellow Jacket district in 1938 was gold ore from the Yellow Jacket mine, treated by concentration. The mine was operated under lease by the Treasure Gold Mining Co.; late in the year it was taken over by the Condor Gold Mining Co., controlled by the International Smelting & Refining Co.

### NEZ PERCE COUNTY

The entire metal output of Nez Perce County in 1938 was placer gold and silver recovered by various operators along the banks of Salmon and Snake Rivers.

### OWYHEE COUNTY

*Carson district (Silver City, De Lamar).*—There were large increases in production of gold in the Carson district in 1938 from both lode and placer properties; the chief output was placer gold recovered by two dredges near De Lamar. Jordan Creek Placers operated its dredge, equipped with sixty-two 3-cubic foot buckets, nearly all the year and treated 605,510 cubic yards of gravel; it was again the largest producer of gold in Owyhee County. Considerable gold was recovered also on Jordan Creek by De Lamar Placers, which operated a dragline and washing plant from March 23 to December 14 and treated 560,000 cubic yards of gravel. The increase in output of lode gold and silver resulted from milling operations at the Trade Dollar and Golden Sunday mines and the De Lamar old tailing dumps; the largest production was derived by concentration of several thousand tons of old tailings from the De Lamar dumps.

*Snake River district.*—Placer gold recovered from Snake River bars near Grand View decreased in 1938 owing to suspension of operations at the dragline dredge of the Triangle Construction Co. The chief producers were the Dollar claim near Hammett and the Murphy and Hightower claims at Grand View.

### POWER COUNTY

Production of gold in Power County was small in 1938, as the dragline dredge, which operated at Bonanza Bar on Snake River in 1937, was idle in 1938.

### SHOSHONE COUNTY

#### COEUR D'ALENE REGION

The value of the metal output of the Coeur d'Alene region decreased 31 percent in 1938. Most of the loss was in lead and zinc production and was due chiefly to suspension of operations at the Morning mine of the Federal Mining & Smelting Co. for 3 months during the summer and to closing of the Star mine of the Sullivan Mining Co. in July. The output of silver also decreased considerably owing to marked decreases at both the Sunshine and Crescent mines. The closing of the lead smelter at East Helena, Mont., for several months in the summer and fall resulted in shut-downs at several Coeur d'Alene

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properties, and declining prices of lead and zinc caused curtailment by nearly all the large producers of zinc-lead ore. About 58 percent of the material produced in Shoshone County in 1938 was zinc-lead ore, 27 percent silver ore, and 14 percent lead ore. The following table gives production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region in 1937 and 1938 and the total for 1884 to 1938.

*Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1937–38, and total, 1884–1938, in terms of recovered metals*

| Year | Lode mines | Placers | Ore | Gold (lode and placer) | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| 1937 | 49 | 38 | 1,731,801 | 3,659 | 18,457,726 | 3,888,157 | 193,010,644 | 94,140,000 | $32,382,311 |
| 1938 | 43 | 20 | 1,514,278 | 4,053 | 17,325,379 | 3,765,795 | 164,547,979 | 63,874,125 | 22,346,313 |
| Total, 1884–1938 | ------ | -------- | (1) | 366,164 | 342,066,466 | [2] 49,541 | [2] 4,866,152 | [2] 636,899 | 854,563,102 |

[1] Figures not available.
[2] Short tons.

*Beaver district.*—The value of the metal output of the Beaver district declined from $344,534 in 1937 to $34,701 in 1938, owing chiefly to the large decrease in output of zinc-lead ore and old tailings from the Interstate-Callahan property, where operations were suspended in February after 3,900 tons of zinc-lead ore had been mined; the ore was treated in the Galena mill near Wallace.

*Coeur d'Alene district.*—Placer gold continued in 1938 to be the chief metal produced in the Coeur d'Alene district, but the output was less than in 1937; most of it was recovered by drift mining at the Beehive Bar, Grove Walker, and Old Dunn claims.

*Eagle district.*—Production of silver, lead, and zinc in the Eagle district in 1938 was about double that in 1937 owing to increase in output of zinc-lead ore and lead ore from the Jack Waite mine, the only producer. The property lies in both Shoshone County, Idaho, and Sanders County, Mont.; the output from the Idaho section of the mine comprised 7,795 tons of zinc-lead ore treated in the mill at Duthie and 221 tons of rich lead ore shipped for smelting.

*Evolution district.*—The value ($8,741,743) of the metal production of the Evolution district in 1938 was larger than that of any district in Idaho, although it was $1,789,309 less than in 1937. The chief production, as in 1937, was silver ore from the Sunshine and Polaris properties. The Sunshine Mining Co. was again the largest producer of silver in the United States; the company operated its 1,100-ton flotation mill continuously and treated 321,605 tons of silver ore, or 65,805 tons more than in 1937, but the output of silver declined from 12,152,000 ounces in 1937 to 11,352,154 ounces in 1938 as the silver content of the ore decreased. Development in 1938 comprised 8,695 feet of drifting, 2,198 feet of diamond drilling, 4,446 feet of raising, 3,038 feet of crosscutting, and 434 feet of sinking. The Polaris Mining Co. operated its 200-ton flotation mill throughout the year and treated 64,405 tons of silver ore, or about double the quantity in 1937; the company ranked third in Idaho in production of silver. The remainder of the district output comprised 1,220 tons of silver

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ore from the Mineral Point mine and 180 tons of ore from the St. Elmo property.

*Hunter district* (*Mullan*).—The value of the metal output of the Hunter district declined from $7,691,893 in 1937 to $4,246,649 in 1938; production of silver decreased 337,099 ounces, lead 15,639,814 pounds, and zinc 15,260,683 pounds. These losses were due to decreases in output of ore from the four chief producers—the Morning, Star, Gold Hunter, and Golconda mines. The Morning mine, the largest producer of zinc in the State, was closed from June 25 to September 21, and the Star mine, a large producer of zinc and lead, was closed in July. The output of the Morning mine comprised 262,329 tons of zinc-lead-silver ore concentrated by flotation (compared with 350,609 tons in 1937) and 621 tons of first-class lead-silver ore smelted. The 800-ton flotation plant at the Star mine treated 42,015 tons of zinc-lead ore from the Star mine and 85,241 tons of zinc-lead ore from the Hecla mine. Lessees operated the Gold Hunter mine throughout the year and treated about 34,000 tons of lead-silver ore in the 500-ton flotation plant owned by Gold Hunter Mines, Inc. The 250-ton flotation plant at the Golconda mine was used to treat zinc-lead ore (about 3,900 tons) from the Golconda mine and old tailings (7,570 tons), containing chiefly zinc and lead, deposited on various properties by canyon streams.

*Lelande district* (*Burke, Mace, Frisco*).—The value of the metal output of the Lelande district declined 30 percent in 1938. The Hecla mine was, as usual, the largest producer of silver and lead in the district, although its output of ore decreased from 250,630 tons in 1937 to 231,848 tons in 1938. The 750-ton concentration plant at the mine was closed during the summer, and extensive alterations were made to convert the plant to a straight flotation mill; during the reconstruction period zinc-lead ore from the Hecla mine was treated in the Star mill. The output of the mine comprised 133,324 tons of lead ore concentrated, 85,241 tons of zinc-lead ore concentrated, and 13,283 tons of first-class lead-silver ore smelted. The Frisco property was operated throughout the year by the Hull Leasing Co.; it was the largest producer of zinc in the district. The company treated 26,500 tons of zinc-lead ore in a 100-ton flotation plant. The Sherman Lead Co., a large producer of lead-silver ore in 1937, suspended operations in June 1938, resulting in a substantial decrease in the yield of lead and silver. The remainder of the district output was largely old tailings (4,008 tons), containing chiefly zinc and lead, concentrated at the Golconda mill.

*Placer Center district.*—There were large decreases in output of zinc and lead in the Placer Center district in 1938 owing to curtailment of operations at the Tamarack mine. While the mine was operated (January to May and November and December), 7,300 tons of zinc-lead ore were treated in the Hercules custom mill. Nearly all the remainder of the district output was lead-silver ore (7,007 tons) from the Dayrock property, concentrated in the Hercules mill; the property was operated throughout the year by the Dayrock Mining Co.

*Summit district* (*Murray*).—The value of the metal output of the Summit district increased from $19,679 in 1937 to $56,736 in 1938, owing chiefly to the increase in output of gold ore from the Idaho Mother Lode and Golden Chest mines. The ore from both properties (about 5,900 tons) was treated in the 100-ton flotation plant owned

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by Idaho Mother Lode Gold Mines, Inc. The Golden Chest mine was operated by Consolidated Gold Mines, Inc. The remainder of the district output was chiefly placer gold produced by Nugget Gulch Placers.

*Yreka district (Kellogg).*—The value of the metal output of the Yreka district decreased 34 percent in 1938. The Bunker Hill & Sullivan Mining & Concentrating Co. was, as usual, the most important mining enterprise in Idaho; it ranked first in output of lead, second in silver, and third in zinc. Operations were continuous throughout 1938 at both the Bunker Hill & Sullivan and Crescent properties, but production declined considerably—zinc-lead ore from the Bunker Hill & Sullivan mine from 388,588 tons in 1937 to 347,315 tons in 1938 and silver ore from the Crescent mine from 30,535 to 26,267 tons. There were marked decreases in silver output from the Crescent mine and in zinc and lead from the Bunker Hill & Sullivan mine. The company reported 10,238 feet of development at the two properties in 1938. The Federal Mining & Smelting Co. operated throughout the year at the Page and Blackhawk mines; zinc-lead ore (71,508 tons from the Page and 11,387 tons from the Blackhawk) was treated in the flotation plant at the Page mine. The capacity of the mill was increased to 450 tons a day. Other producers in the Yreka district in 1938 included the Caledonia, Sidney, and Sierra Nevada mines.

### TWIN FALLS COUNTY

The entire output of Twin Falls County in 1938 was placer gold and silver recovered by various operators along the banks of Snake River near Twin Falls, Kimberly, and Hansen.

### VALLEY COUNTY

*Deadwood Basin district.*—Nearly all the output of the Deadwood Basin district in 1938 was lead-silver ore from the Lost Pilgrim mine and gold ore from the W. J. L. claim. The Lost Pilgrim mine had been idle since 1932.

*Pistol Creek district.*—The Lucky Boy mine near Landmark was the only producer in the Pistol Creek district in 1938; 348 tons of lead ore rich in gold and silver were shipped to a smelter in Utah.

*Thunder Mountain district.*—Most of the output from the Thunder Mountain district in 1938 was gold ore from the Sunnyside mine operated by the Thunder Mountain Mining & Milling Co.; about 3,600 tons of gold ore were treated by amalgamation and concentration.

*Yellow Pine district.*—The Meadow Creek property near Stibnite was operated by the Yellow Pine Co. until August 1, 1938, and the remainder of the year by the Bradley Mining Co.; all assets of the Yellow Pine Co. were acquired by the Bradley Mining Co. the first of August. The 200-ton flotation mill was operated throughout the year on ore containing chiefly gold, antimony, and silver, but production of gold and silver was much less than in 1937.

### WASHINGTON COUNTY

The output from mines in Washington County in 1938 was virtually the same as in 1937, as shipments of silver ore containing lead and copper were maintained from the Silver Still property near Mineral.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By T. H. Miller and Paul Luff

## SUMMARY OUTLINE


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The value of the metal output from mines in Montana decreased 52 percent in 1938 compared with 1937, owing to curtailment in output of copper ore and zinc-lead ore and to lower average prices of silver, copper, lead, and zinc. The output of gold increased slightly, because of regular operations at cyanidation mills, but the output of silver, copper, lead, and zinc decreased markedly. The Anaconda Copper Mining Co. operated the copper mines at Butte at a greatly reduced rate in 1938, and the zinc mines of the company were virtually nonproductive. The output of base ores in Silver Bow, Granite, Jefferson, and Sanders Counties decreased, but the output of gold ore in several counties increased substantially.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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*Mine production of gold, silver, copper, lead, and zinc in Montana, 1934–38, and total, 1862–1938, in terms of recovered metals*

| Year | Mines producing | | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 583 | 654 | 1,066,952 | 97,445.95 | $3,405,736 | 4,006,468 | $2,590,040 |
| 1935 | 681 | 551 | 2,412,113 | 151,088.03 | 5,288,081 | 9,322,951 | 6,700,871 |
| 1936 | 570 | 284 | 3,853,116 | 180,209.20 | 6,307,322 | 11,600,563 | 8,984,636 |
| 1937 | 615 | 406 | 4,898,009 | 202,252.00 | 7,078,820 | 11,812,093 | 9,136,654 |
| 1938 | 482 | 265 | 2,724,466 | 203,313.00 | 7,115,955 | 6,403,962 | 4,139,935 |
| 1862–1938 | | | [1] | 15,897,268.00 | 340,857,592 | 679,367,364 | 497,429,579 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 63,265,000 | $5,061,200 | 20,010,000 | $740,370 | 61,442,256 | $2,642,017 | $14,439,363 |
| 1935 | 154,957,470 | 12,861,470 | 31,177,525 | 1,247,101 | 109,561,477 | 4,820,705 | 30,918,228 |
| 1936 | 219,088,000 | 20,156,096 | 38,118,000 | 1,753,428 | 99,434,000 | 4,971,700 | 42,173,182 |
| 1937 | 289,056,000 | 34,975,776 | 35,914,000 | 2,118,926 | 78,336,000 | 5,091,840 | 58,402,016 |
| 1938 | 154,426,000 | 15,133,748 | 18,654,000 | 858,084 | 17,688,000 | 849,024 | 28,096,746 |
| 1862–1938 | [2] 5,685,203 | 1,678,770,584 | [2] 566,392 | 60,224,372 | [2] 1,551,571 | 235,439,872 | 2,812,721,999 |

[1] Figures not available.
[2] Short tons.

*Gold and silver produced at placer mines in Montana, 1934–38, in fine ounces, in terms of recovered metals*

| Year | Sluicing and hydraulic | | Dry-land dredges [1] | | Floating dredges | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| 1934 | 5,607.71 | 686 | 4,877.79 | 889 | 15,058.39 | 1,562 | 25,543.89 | 3,137 |
| 1935 | 4,586.48 | 647 | 9,031.88 | 1,554 | 12,680.87 | 1,294 | 26,299.23 | 3,495 |
| 1936 | 2,803.02 | 338 | 18,312.43 | 3,393 | 19,300.35 | 1,923 | 40,415.80 | 5,654 |
| 1937 | 2,989.00 | 369 | 15,844.00 | 4,249 | 17,564.00 | 1,797 | 36,397.00 | 6,415 |
| 1938 | 3,896.00 | 351 | 10,096.00 | 2,943 | 21,356.00 | 3,240 | 35,348.00 | 6,534 |

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

*Gold.*—The output of gold in Montana in 1938 increased 1,061 ounces over 1937 (gold from lode mines increasing 2,110 ounces but gold from placer mines decreasing 1,049 ounces). Gold production in Madison County increased 19,395 ounces, owing chiefly to increased output of gold ore at the West Mayflower, Revenue, and Victoria mines. Gold output from Beaverhead and Broadwater Counties also increased, but large decreases were noted in Granite, Silver Bow, Park, Phillips, Jefferson, Deer Lodge, Powell, and Lewis and Clark Counties. There was a marked increase in yield of gold from the Butte Highlands property southeast of Butte, but this gain was more than offset by decreases in gold from both the copper and zinc mines at Butte. Large decreases also in gold output were reported at the Jardine mine in Park County, the Ruby Gulch and Little Ben mines in Phillips County, and the Spring Hill mine near Helena. Several new placer operations were started during 1938, including the new Yuba dredges of Winston Bros. on Prickly Pear Creek and Perry-

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Schroeder Mining Co. on Hauser Lake and the dragline and washer plants of Ralph E. Davis Syndicate on Grasshopper Creek, Kit Carson Placers on Lowland Creek, and Norman Rogers Mining Co. on Elk Creek; but gains from these plants were more than offset by losses due to suspension of operations on Clancey Creek by the Humphreys Gold Corporation. The lead smelter at East Helena was closed for more than 3 months during the summer, and the copper plant at Anaconda was closed to shippers of siliceous ores during part of the year. As a result, many shippers of siliceous ores and concentrates were forced to suspend operations during part of 1938, and the gold output

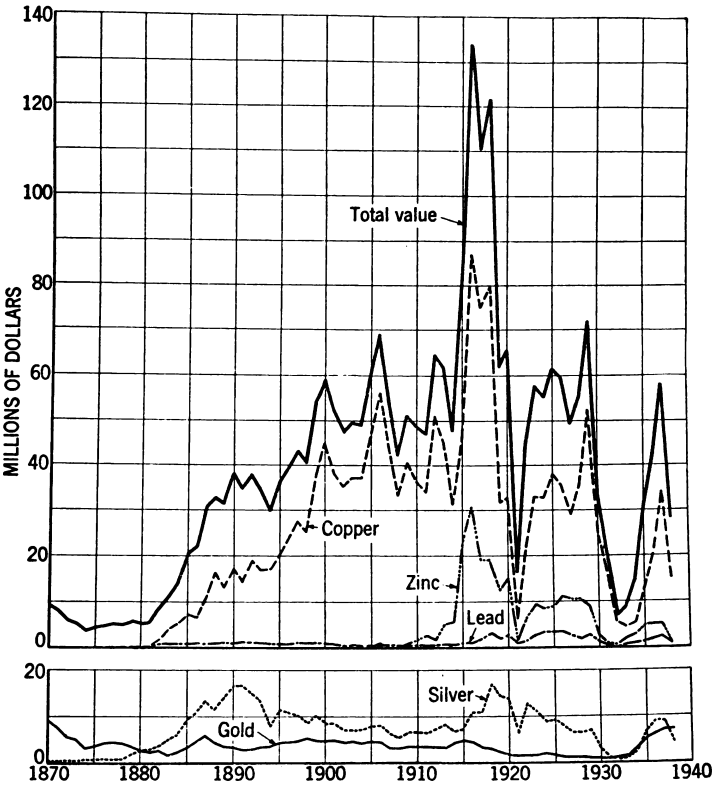


FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana, 1870–1938.

in many mining districts decreased. The output of gold ore, which yielded 75 percent of the State gold, increased from 644,596 tons in 1937 to 756,223 tons in 1938; the 1938 output comprised 433,233 tons treated at cyanidation plants (310,979 tons in 1937), 77,478 tons treated at amalgamation plants, 190,709 tons treated at concentration plants, and 54,803 tons shipped crude to smelters. The West Mayflower mine in the Renova district, Madison County, was the largest producer of gold in Montana in 1938; other large producers were the Ruby Gulch mine at Zortman, Porter Bros. dredge at Helena, the Butte Highlands mine southeast of Butte, and the Golden Messenger mine at York.

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*Silver.*—The output of silver in Montana in 1938 decreased 46 percent in quantity and 55 percent in value from 1937, owing chiefly to suspension of mining of zinc-lead ores and curtailment in mining of copper ores at Butte by the Anaconda Copper Mining Co. Silver from Silver Bow County decreased 4,053,327 ounces. The zinc concentrator at Anaconda was closed nearly all the year, causing a marked decrease in silver from custom shippers to the mill from mines near Philipsburg in Granite County (silver from Granite County decreased 1,013,138 ounces). Silver from the Flathead mine of the Anaconda Copper Mining Co. was slightly less than in 1937. There were decreases in silver output in Jefferson and Lewis and Clark Counties, but increases were reported from Cascade and Madison Counties. Copper ore yielded 60 percent of the State total silver, silver ore 23 percent, zinc-lead ore 7 percent, and gold ore 6 percent. Nearly 74 percent of the total silver came from ore concentrated and 24 percent from crude ore shipped for smelting. The output of silver ore decreased from 246,325 tons in 1937 to 150,930 tons in 1938. In addition to the copper mines at Butte and the Flathead mine (all operated by the Anaconda Copper Mining Co.), the Comet mine near Basin, the Trout, Granite Bimetallic, Two Percent, and Silver Prince mines near Philipsburg, and the Big Seven and Florence mines near Neihart were important silver producers.

*Copper.*—The output of recoverable copper in Montana in 1938 decreased 47 percent in quantity and 57 percent in value from 1937. The Anaconda Copper Mining Co. was, as usual, the only important copper producer in the State; its mines at Butte, however, were operated at a greatly reduced rate during 1938, and the quantity of copper ore sent to the mill at Anaconda decreased from 3,068,665 to 1,561,186 tons. The sand-leaching plant at Anaconda was not operated in 1938 (in 1937 it treated 307,014 tons of old tailings by a combination of leaching and flotation concentration). Copper from mine-water precipitates also decreased.

*Lead and zinc.*—Marked decreases were recorded in output of recoverable lead and zinc in Montana in 1938 compared with 1937; lead decreased 48 percent in quantity and 60 percent in value, and zinc 77 percent in quantity and 83 percent in value. Most of the decrease in both metals can be ascribed to reduced activity in the Butte district, normally the chief producing area. The zinc mines of the Anaconda Copper Mining Co. were closed throughout the year, except for development that produced a limited quantity of zinc-lead ore, and the Emma mine was productive in January only; as a result, the output of zinc-lead ore from Silver Bow County dropped to 9,894 tons in 1938. The zinc concentrator at Anaconda was closed most of the year, and custom receipts from mines near Philipsburg declined to 50,023 tons. Decreases in production of zinc-lead ore were reported also from the Comet mine near Basin and the Jack Waite mine in Sanders County. The Jack Waite, Comet, and Flathead mines were the chief lead producers in Montana in 1938, yielding 73 percent of the State total. Nearly 69 percent of the State total zinc in 1938 came from the slag-fuming plant of the Anaconda Copper Mining Co. at East Helena; the plant was closed during the summer and fall, and the output of both zinc and lead decreased markedly.

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## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Montana in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value |
| Beaverhead | 24 | 8 | 12,154 | $425,390 | 70,406 | $45,515 |
| Broadwater | 50 | 19 | 10,871 | 380,485 | 28,478 | 18,410 |
| Cascade | 9 | | 1,197 | 41,895 | 305,893 | 197,749 |
| Deer Lodge | 12 | 8 | 3,818 | 133,630 | 3,499 | 2,262 |
| Fergus | 6 | 2 | 2,769 | 96,915 | 3,779 | 2,443 |
| Flathead | 3 | | 640 | 22,400 | 521,532 | 337,152 |
| Granite | 41 | 20 | 9,532 | 333,620 | 595,502 | 384,971 |
| Jefferson | 65 | 15 | 19,180 | 671,300 | 399,120 | 258,017 |
| Judith Basin | 1 | | 38 | 1,330 | 12,324 | 7,967 |
| Lewis and Clark | 54 | 53 | 34,857 | 1,219,995 | 77,984 | 50,414 |
| Liberty | | 2 | 12 | 420 | | |
| Lincoln | 9 | 9 | 2,400 | 84,000 | 4,817 | 3,114 |
| Madison | 122 | 16 | 50,370 | 1,762,950 | 165,098 | 106,730 |
| Meagher | 1 | 11 | 365 | 12,775 | 71 | 46 |
| Mineral | 1 | 18 | 673 | 23,555 | 31 | 20 |
| Missoula | 10 | 15 | 1,266 | 44,310 | 3,267 | 2,112 |
| Park | 7 | 4 | 8,229 | 288,015 | 6,217 | 4,019 |
| Phillips | 2 | 4 | 18,927 | 662,445 | 76,660 | 49,558 |
| Powell | 20 | 29 | 9,611 | 336,385 | 35,371 | 22,866 |
| Ravalli | 3 | 8 | 437 | 15,295 | 40,248 | 26,019 |
| Sanders | 4 | 2 | 108 | 3,780 | 35,425 | 22,901 |
| Silver Bow | 38 | 17 | 15,147 | 530,145 | 4,018,192 | 2,597,619 |
| Sweet Grass | | 2 | 11 | 385 | | |
| Toole | | 3 | 701 | 24,535 | 48 | 31 |
| | 482 | 265 | 203,313 | 7,115,955 | 6,403,962 | 4,139,935 |
| Total, 1937 | 615 | 406 | 202,252 | 7,078,820 | 11,812,093 | 9,136,654 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Beaverhead | 60,857 | $5,964 | 320,826 | $14,758 | | | $491,627 |
| Broadwater | 4,908 | 481 | 248,652 | 11,438 | | | 410,814 |
| Cascade | 3,786 | 371 | 424,065 | 19,507 | | | 259,522 |
| Deer Lodge | 1,806 | 177 | | | | | 136,069 |
| Fergus | 204 | 20 | 3,000 | 138 | | | 99,516 |
| Flathead | 796 | 78 | 2,427,000 | 111,642 | | | 471,272 |
| Granite | 82,949 | 8,129 | 234,435 | 10,784 | 852,708 | $40,930 | 778,434 |
| Jefferson | 304,398 | 29,831 | 3,322,631 | 152,841 | 1,209,417 | 58,052 | 1,170,041 |
| Judith Basin | 2,959 | 290 | 565,087 | 25,994 | | | 35,581 |
| Lewis and Clark | 18,929 | 1,855 | 1,604,630 | 73,813 | 12,145,833 | 583,000 | 1,929,077 |
| Liberty | | | | | | | 420 |
| Lincoln | 296 | 29 | 59,739 | 2,748 | 12,625 | 606 | 90,497 |
| Madison | 116,367 | 11,404 | 233,870 | 10,758 | | | 1,891,842 |
| Meagher | | | | | | | 12,821 |
| Mineral | | | | | | | 23,575 |
| Missoula | 27,735 | 2,718 | 739 | 34 | | | 49,174 |
| Park | 6,204 | 608 | 22,370 | 1,029 | | | 293,671 |
| Phillips | | | | | | | 712,003 |
| Powell | 990 | 97 | 76,152 | 3,503 | | | 362,851 |
| Ravalli | 33,969 | 3,329 | 93,130 | 4,284 | 484,000 | 23,232 | 72,159 |
| Sanders | 48,990 | 4,801 | 8,602,696 | 395,724 | 1,100,000 | 52,800 | 480,006 |
| Silver Bow | 153,709,857 | 15,063,566 | 414,978 | 19,089 | 1,883,417 | 90,404 | 18,300,823 |
| Sweet Grass | | | | | | | 385 |
| Toole | | | | | | | 24,566 |
| | 154,426,000 | 15,133,748 | 18,654,000 | 858,084 | 17,688,000 | 849,024 | 28,096,746 |
| Total 1937 | 289,056,000 | 34,975,776 | 35,914,000 | 2,118,926 | 78,336,000 | 5,091,840 | 58,402,016 |

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*Gold and silver produced at lode mines in Montana in 1938, by counties, in terms of recovered metals*

| County | Ore sold or treated | Gold | Silver | County | Ore sold or treated | Gold | Silver |
|---|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | | *Short tons* | *Fine ounces* | *Fine ounces* |
| Beaverhead | 47,317 | 10,632 | 70,307 | Meagher | 14 | 24 | 3 |
| Broadwater | 61,476 | 10,012 | 28,345 | Mineral | 35 | 15 | |
| Cascade | 37,033 | 1,197 | 305,893 | Missoula | 1,187 | 566 | 3,202 |
| Deer Lodge | 24,057 | 3,792 | 3,499 | Park | 50,537 | 8,013 | 6,200 |
| Fergus | 30,128 | 2,763 | 3,779 | Phillips | 164,108 | 18,905 | 76,660 |
| Flathead | 21,016 | 640 | 521,532 | Powell | 4,558 | 2,285 | 34,534 |
| Granite | 94,800 | 9,280 | 595,468 | Ravalli | 18,490 | 390 | 40,245 |
| Jefferson | 102,050 | 9,758 | 395,440 | Sanders | 44,730 | 86 | 35,425 |
| Judith Basin | 780 | 38 | 12,324 | Silver Bow | 1,642,491 | 15,021 | 4,018,161 |
| Lewis and Clark | 225,626 | 24,018 | 76,926 | | | | |
| Lincoln | 17,257 | 2,101 | 4,800 | | 2,724,466 | 167,965 | 6,397,428 |
| Madison | 136,776 | 48,429 | 164,685 | Total, 1937 | 4,898,009 | 165,855 | 11,805,678 |

*Gold and silver produced at placer mines in Montana in 1938, by counties, in fine ounces, in terms of recovered metals*

| County | Sluicing and hydraulic | | Dry-land dredges [1] | | Floating dredges | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| Beaverhead | 34 | 1 | 1,488 | 98 | | | 1,522 | 99 |
| Broadwater | 183 | 13 | 676 | 120 | | | 859 | 133 |
| Deer Lodge | 26 | | | | | | 26 | |
| Fergus | 6 | | | | | | 6 | |
| Granite | 237 | 34 | 15 | | | | 252 | 34 |
| Jefferson | 55 | 3 | 6,302 | 2,547 | 3,065 | 1,130 | 9,422 | 3,680 |
| Lewis and Clark | 866 | 77 | 131 | 28 | 9,842 | 953 | 10,839 | 1,058 |
| Liberty | 12 | | | | | | 12 | |
| Lincoln | 93 | 6 | 206 | 11 | | | 299 | 17 |
| Madison | 104 | 17 | | | 1,837 | 396 | 1,941 | 413 |
| Meagher | 145 | 20 | 196 | 48 | | | 341 | 68 |
| Mineral | 519 | 29 | 139 | 2 | | | 658 | 31 |
| Missoula | 700 | 65 | | | | | 700 | 65 |
| Park | 216 | 17 | | | | | 216 | 17 |
| Phillips | 22 | | | | | | 22 | |
| Powell | 444 | 34 | 270 | 42 | 6,612 | 761 | 7,326 | 837 |
| Ravalli | 47 | 3 | | | | | 47 | 3 |
| Sanders | 22 | | | | | | 22 | |
| Silver Bow | 126 | 31 | | | | | 126 | 31 |
| Sweet Grass | 11 | | | | | | 11 | |
| Toole | 28 | 1 | 673 | 47 | | | 701 | 48 |
| | 3,896 | 351 | 10,096 | 2,943 | 21,356 | 3,240 | 35,348 | 6,534 |
| Total, 1937 | 2,989 | 369 | 15,844 | 4,249 | 17,564 | 1,797 | 36,397 | 6,415 |

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

## MINING INDUSTRY

The output of both copper ore and zinc-lead ore decreased markedly in 1938 compared with 1937, causing sharp declines in output of silver, copper, lead, and zinc, but the output of gold ore continued to increase. Gold recovered from gold ore increased 21,534 ounces and more than offset the decrease of 14,939 ounces in gold from base ores. Nearly all the increase in output of gold ore was made at mines that recently have been equipped with new or rebuilt cyanidation mills; gold ore treated by cyanidation increased from 310,979 to 433,233 tons. Despite the large decrease in output of base ores from Butte the output of gold in Montana increased slightly in 1938, owing chiefly to regular operations at cyanidation mills.

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### ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore sold or treated in Montana in 1938, with content in terms of recovered metals*

| Source | Mines producing | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 316 | 756,223 | 151,831 | 363,535 | 201,594 | 558,860 | |
| Dry and siliceous gold-silver ore | 30 | 7,448 | 2,179 | 116,845 | 31,127 | 13,488 | |
| Dry and siliceous silver ore | 65 | 150,930 | 3,896 | 1,475,625 | 150,680 | 856,175 | |
| | [1] 410 | 914,601 | 157,906 | 1,956,005 | 383,401 | 1,428,523 | |
| Copper ore | 12 | 1,607,713 | 4,965 | 3,859,576 | [2] 153,705,293 | | |
| Lead ore | 68 | 10,574 | 1,471 | 122,203 | 29,922 | 5,524,156 | |
| Zinc ore | 1 | [3] 76,809 | | 9,357 | | 1,419,130 | 12,126,833 |
| Zinc-lead ore | 13 | 114,769 | 3,623 | 450,287 | 307,384 | 10,282,191 | 5,561,167 |
| Total, lode mines | [1] 482 | 2,724,466 | 167,965 | 6,397,428 | [2] 154,426,000 | 18,654,000 | 17,688,000 |
| Total, placers | 265 | | 35,348 | 6,534 | | | |
| | 747 | 2,724,466 | 203,313 | 6,403,962 | [2] 154,426,000 | 18,654,000 | 17,688,000 |
| Total, 1937 | 1,021 | 4,898,009 | 202,252 | 11,812,093 | [4] 289,056,000 | 35,914,000 | 78,336,000 |

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 5,563,800 pounds recovered from precipitates.
[3] Current slag fumed.
[4] Includes 9,614,024 pounds recovered from precipitates.

## METALLURGIC INDUSTRY

Lode mines in Montana produced 2,724,466 tons of ore and old tailings in 1938 compared with 4,898,009 tons in 1937. The 1938 output comprised 77,478 tons treated at amalgamation mills, 433,233 tons treated at cyanidation mills, 1,976,828 tons treated at concentration mills, 160,118 tons shipped crude to smelters, and 76,809 tons treated at a slag-fuming plant.

Twenty straight cyanidation mills operated in Montana in 1938 and treated 433,233 tons of ore and old tailings, an increase from 310,979 tons in 1937. Twelve of these plants treated 392,307 tons of material containing 67,570 ounces of gold and 198,834 ounces of silver and produced bullion yielding 59,443 ounces of gold and 114,340 ounces of silver, indicating cyanide extractions of 88 percent of the gold and 58 percent of the silver; the 12 plants used 196,866 pounds of 91-percent grade sodium cyanide, 70,038 pounds of zinc dust, and 3,581,351 pounds of lime. Three of them reported the consumption of 1,160 pounds of lead acetate.

Ore treated at concentration mills decreased from 4,167,560 tons in 1937 to 1,976,828 tons in 1938. The 1938 total comprised 190,709 tons of gold ore, 109,546 tons of silver ore, 1,561,804 tons of copper ore, and 114,769 tons of zinc-lead ore.

Details of the treatment of all ores produced in Montana in 1938 are given in the tables that follow.

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*Mine production of metals in Montana in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore amalgamated | 77,478 | 9,492 | 2,050 | | | |
| Ore cyanided | 433,233 | 64,759 | 120,062 | | | |
| Concentrates smelted [1] | 353,378 | 34,700 | 4,724,662 | 145,432,695 | 11,257,191 | 5,561,167 |
| Copper precipitates smelted | 4,045 | | | 5,563,800 | | |
| Ore smelted | 160,118 | 59,014 | 1,541,297 | 3,429,505 | 5,977,679 | |
| Slag fumed | 76,809 | | 9,357 | | 1,419,130 | 12,126,833 |
| Placer | | 35,348 | 6,534 | | | |
| Total, 1937 | | 203,313 | 6,403,962 | 154,426,000 | 18,654,000 | 17,688,000 |
| | | 202,252 | 11,812,093 | 289,056,000 | 35,914,000 | 78,336,000 |

[1] Includes zinc concentrates treated at electrolytic plants.

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Montana in 1938, by types of mills and by counties, in terms of recovered metals*

AMALGAMATION MILLS

| County | Material treated | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Beaverhead | 75 | 25 | 2 | | | | | |
| Broadwater | 1,671 | 418 | 56 | 40 | 18 | 61 | 7 | 1,380 |
| Deer Lodge | 1,288 | 162 | 12 | | | | | |
| Granite | 300 | 41 | 15 | 3 | 33 | 39 | | |
| Jefferson | 1,899 | 306 | 59 | 34 | 71 | 410 | 1,082 | 1,978 |
| Lewis and Clark | 168 | 35 | 25 | 2 | 5 | 24 | | |
| Lincoln | 17,035 | 1,806 | 348 | 89 | 285 | 2,361 | 296 | 11,444 |
| Madison | 4,103 | 629 | 603 | 116 | 349 | 2,110 | 174 | 2,604 |
| Missoula | 400 | 115 | 15 | 12 | 20 | 13 | | |
| Park | 50,088 | 5,830 | 895 | 1,262 | 1,819 | 420 | | |
| Powell | 416 | 104 | 20 | 41 | 39 | 249 | | 2,752 |
| Ravalli | 35 | 21 | | | | | | |
| Total, 1937 | 77,478 | 9,492 | 2,050 | 1,599 | 2,639 | 5,687 | 1,559 | 20,158 |
| | 85,039 | 12,955 | 2,682 | 1,459 | 3,633 | 12,861 | 576 | 25,000 |

CYANIDATION MILLS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Beaverhead | 41,201 | 9,176 | 6,156 | | | | | |
| Deer Lodge | 22,190 | 3,316 | 348 | | | | | |
| Fergus | 30,006 | 2,758 | 1,454 | | | | | |
| Granite | 24,139 | 4,674 | 152 | | | | | |
| Jefferson | 8,037 | 228 | 31 | | | | | |
| Lewis and Clark | 86,652 | 14,713 | 40,637 | | | | | |
| Madison | 39,517 | 4,828 | 4,240 | | | | | |
| Phillips | 163,506 | 16,217 | 66,023 | | | | | |
| Silver Bow | 17,985 | 8,849 | 1,021 | | | | | |
| Total, 1937 | 433,233 | 64,759 | 120,062 | | | | | |
| | 310,979 | 50,582 | 117,956 | | | | | |
| Grand total: 1938 | 510,711 | 74,251 | 122,112 | 1,599 | 2,639 | 5,687 | 1,559 | 20,158 |
| 1937 | 396,018 | 63,537 | 120,638 | 1,459 | 3,633 | 12,861 | 576 | 25,000 |

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*Mine production of metals from concentrating mills in Montana in 1938, by counties, in terms of recovered metals*

| County | Ore treated | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|
| | | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Broadwater | 57,313 | 5,982 | 6,820 | 3,872 | 1,880 | 44,100 | |
| Cascade | 36,927 | 1,254 | 1,056 | 289,099 | 3,524 | 408,939 | |
| Granite | 48,494 | 2,259 | 883 | 245,058 | 26,962 | 199,753 | 852,708 |
| Jefferson | 81,780 | 12,731 | 5,069 | 326,596 | 258,024 | 2,964,174 | 1,209,417 |
| Lewis and Clark | 56,586 | 2,772 | 5,607 | 6,915 | 8,863 | 138,430 | 19,000 |
| Lincoln | 108 | 32 | | 309 | | 19,947 | 12,625 |
| Madison | 62,682 | 3,394 | 8,183 | 11,983 | 92,912 | | |
| Ravalli | 17,850 | 721 | 151 | 35,920 | 7,778 | 93,130 | 484,000 |
| Sanders | 43,390 | 5,739 | 74 | 29,524 | 41,428 | 6,959,995 | 1,100,000 |
| Silver Bow | 1,571,698 | 316,895 | 4,218 | 3,769,699 | 144,989,765 | 408,565 | 1,883,417 |
| Total, 1937 | 1,976,828 | 351,779 | 32,061 | 4,718,975 | 145,431,136 | 11,237,033 | 5,561,167 |
| | 4,167,560 | 653,919 | 46,391 | 9,634,934 | 274,457,499 | 27,206,506 | 57,676,000 |

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*Gross metal content of concentrates produced from ore mined in Montana in 1938, by classes of concentrates*

| Class of concentrates | Concentrates | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 13,015 | 17,406 | 19,816 | 24,688 | 162,878 | |
| Dry silver | 1,554 | 1,821 | 304,699 | 6,966 | 64,900 | |
| Copper | 316,099 | 9,130 | 3,727,614 | 148,207,241 | | |
| Lead | 9,977 | 3,938 | 496,220 | 239,712 | 10,895,692 | 520,469 |
| Zinc | 5,826 | 369 | 120,200 | 98,973 | 354,223 | 6,178,733 |
| Iron (from zinc-lead ore) | 6,907 | 2,036 | 56,113 | 69,324 | 262,382 | 982,961 |
| Total, 1937 | 353,378 | 34,700 | 4,724,662 | 148,646,904 | 11,740,075 | 7,682,163 |
| | 655,378 | 50,024 | 9,647,795 | 284,546,967 | 28,734,876 | 68,834,160 |

*Mine production of metals from Montana concentrates shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Broadwater | 6,022 | 6,838 | 3,933 | 1,887 | 45,480 | |
| Cascade | 1,254 | 1,056 | 289,099 | 3,524 | 408,939 | |
| Granite | 2,262 | 916 | 245,097 | 26,962 | 199,753 | 852,708 |
| Jefferson | 12,765 | 5,140 | 327,006 | 259,106 | 2,966,152 | 1,209,417 |
| Lewis and Clark | 2,774 | 5,612 | 6,939 | 8,863 | 138,430 | 19,000 |
| Lincoln | 121 | 285 | 2,670 | 296 | 31,391 | 12,625 |
| Madison | 3,510 | 8,532 | 14,093 | 93,086 | 2,604 | |
| Missoula | 12 | 20 | 13 | | | |
| Park | 1,262 | 1,819 | 420 | | | |
| Powell | 41 | 39 | 249 | | 2,752 | |
| Ravalli | 721 | 151 | 35,920 | 7,778 | 93,130 | 484,000 |
| Sanders | 5,739 | 74 | 29,524 | 41,428 | 6,959,995 | 1,100,000 |
| Silver Bow | 316,895 | 4,218 | 3,769,699 | 144,989,765 | 408,565 | 1,883,417 |
| Total, 1937 | 353,378 | 34,700 | 4,724,662 | 145,432,695 | 11,257,191 | 5,561,167 |
| | 655,378 | 50,024 | 9,647,795 | 274,458,075 | 27,231,506 | 57,676,000 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 13,015 | 17,406 | 19,816 | 20,979 | 156,363 | |
| Dry silver | 1,554 | 1,821 | 304,699 | 5,831 | 62,401 | |
| Copper | 316,099 | 9,130 | 3,727,614 | 145,042,091 | | |
| Lead | 9,977 | 3,938 | 496,220 | 209,415 | 10,459,310 | |
| Zinc | 5,826 | 369 | 120,200 | 94,402 | 336,505 | 5,561,167 |
| Iron (from zinc-lead ore) | 6,907 | 2,036 | 56,113 | 59,977 | 242,612 | |
| | 353,378 | 34,700 | 4,724,662 | 145,432,695 | 11,257,191 | 5,561,167 |

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*Gross metal content of Montana crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | Gross metal content | | | |
|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 54,803 | 52,918 | 205,154 | 84,247 | 292,040 |
| Dry and siliceous gold-silver | 7,448 | 2,179 | 116,845 | 32,135 | 14,309 |
| Dry and siliceous silver | 41,384 | 1,594 | 954,150 | 100,527 | 226,782 |
| Copper | 45,909 | 852 | 142,945 | 3,359,476 | |
| Lead | 10,574 | 1,471 | 122,203 | 36,167 | 5,729,218 |
| | 160,118 | 59,014 | 1,541,297 | 3,612,552 | 6,262,349 |
| Total, 1937 | 213,536 | 52,294 | 2,016,574 | 5,185,430 | 6,593,547 |

*Mine production of metals from Montana crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead |
|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Beaverhead | 6,041 | 1,431 | 64,149 | 60,857 | 320,826 |
| Broadwater | 2,492 | 2,756 | 24,356 | 3,021 | 203,172 |
| Cascade | 106 | 141 | 16,794 | 262 | 15,126 |
| Deer Lodge | 579 | 314 | 3,139 | 1,806 | |
| Fergus | 122 | 5 | 2,325 | 204 | 3,000 |
| Flathead | 21,016 | 640 | 521,532 | 796 | 2,427,000 |
| Granite | 21,867 | 3,649 | 350,204 | 55,987 | 34,682 |
| Jefferson | 10,334 | 4,084 | 68,344 | 45,292 | 356,479 |
| Judith Basin | 780 | 38 | 12,324 | 2,959 | 565,087 |
| Lewis and Clark | 5,411 | 3,658 | 19,968 | 10,066 | 47,070 |
| Lincoln | 114 | 10 | 1,782 | | 28,348 |
| Madison | 30,474 | 34,440 | 145,749 | 23,281 | 231,266 |
| Meagher | 14 | 24 | 3 | | |
| Mineral | 35 | 15 | | | |
| Missoula | 787 | 431 | 3,174 | 27,735 | 739 |
| Park | 449 | 364 | 4,885 | 6,204 | 22,370 |
| Phillips | 602 | 2,688 | 10,637 | | |
| Powell | 4,142 | 2,142 | 34,265 | 990 | 73,400 |
| Ravalli | 605 | 218 | 4,325 | 26,191 | |
| Sanders | 1,340 | 12 | 5,901 | 7,562 | 1,642,701 |
| Silver Bow | 52,808 | 1,954 | 247,441 | 3,156,292 | 6,413 |
| | 160,118 | 59,014 | 1,541,297 | 3,429,505 | 5,977,679 |
| Total, 1937 | 213,536 | 52,294 | 2,016,574 | 4,983,901 | 6,326,494 |

BY CLASSES OF ORE

| | | | | | |
|---|---|---|---|---|---|
| Dry and siliceous gold | 54,803 | 52,918 | 205,154 | 79,750 | 275,309 |
| Dry and siliceous gold-silver | 7,448 | 2,179 | 116,845 | 31,127 | 13,488 |
| Dry and siliceous silver | 41,384 | 1,594 | 954,150 | 96,392 | 164,726 |
| Copper | 45,909 | 852 | 142,945 | 3,192,314 | |
| Lead | 10,574 | 1,471 | 122,203 | 29,922 | 5,524,156 |
| | 160,118 | 59,014 | 1,541,297 | 3,429,505 | 5,977,679 |

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in Montana in 1938, by counties and districts, in terms of recovered metals*

| County and district | Mines producing | | Ore | Gold | | | Silver | | | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Beaverhead County: | | | | | | | | | | | | | |
| Argenta | 12 | | 33,487 | 8,319 | | 8,319 | 9,866 | | 9,866 | 1,265 | 100,826 | | $302,305 |
| Bannack | 3 | 4 | 10,334 | 2,150 | 1,509 | 3,659 | 6,008 | 99 | 6,107 | 3,296 | 2,043 | | 132,430 |
| Big Hole | 4 | 3 | 103 | 36 | 11 | 47 | 17 | | 17 | 500 | | | 1,705 |
| Bryant | 1 | | 2,654 | 126 | | 126 | 41,911 | | 41,911 | 54,296 | 217,957 | | 46,851 |
| Vipond | 3 | | 722 | 1 | | 1 | 12,242 | | 12,242 | 1,500 | | | 8,096 |
| Broadwater County: | | | | | | | | | | | | | |
| Backer | 7 | 13 | 156 | 292 | 786 | 1,078 | 693 | 130 | 823 | 1,510 | 7,652 | | 38,762 |
| Beaver | 11 | | 10,106 | 2,289 | | 2,289 | 12,952 | | 12,952 | 1,786 | 110,131 | | 93,729 |
| Cedar Plains | 14 | | 48,839 | 6,284 | | 6,284 | 4,834 | | 4,834 | 1,408 | 7,108 | | 223,530 |
| Park | 18 | 5 | 2,375 | 1,147 | 68 | 1,215 | 9,866 | 3 | 9,869 | 204 | 123,761 | | 54,618 |
| Cascade County: Montana | 9 | | 37,033 | 1,197 | | 1,197 | 305,893 | | 305,893 | 3,786 | 424,065 | | 259,522 |
| Deer Lodge County: | | | | | | | | | | | | | |
| Dry Gulch | | 3 | | | 9 | 9 | | | | | | | 315 |
| French Gulch | | 2 | | | 8 | 8 | | | | | | | 280 |
| Georgetown | 6 | | 23,855 | 3,768 | | 3,768 | 546 | | 546 | 1,010 | | | 132,332 |
| Heber | 1 | 2 | 11 | 3 | 7 | 10 | 51 | | 51 | | | | 383 |
| Oro Fino | 3 | | 105 | 21 | | 21 | 1,383 | | 1,383 | 112 | | | 1,640 |
| Silver Lake | 2 | | 86 | | | | 1,519 | | 1,519 | 684 | | | 1,049 |
| Fergus County: | | | | | | | | | | | | | |
| North Moccasin | 2 | | 30,006 | 2,758 | | 2,758 | 1,454 | | 1,454 | | | | 97,470 |
| Warm Springs | 3 | 2 | 116 | 5 | 6 | 11 | 2,311 | | 2,311 | | | | 1,879 |
| Flathead County: Hog Heaven | 3 | | 21,016 | 640 | | 640 | 521,532 | | 521,532 | 796 | 2,427,000 | | 471,272 |
| Granite County: | | | | | | | | | | | | | |
| Alps | | 3 | | | 9 | 9 | | | | | | | 315 |
| Boulder | 5 | 2 | 432 | 129 | 81 | 210 | 1,700 | 3 | 1,703 | 1,245 | 4,065 | | 8,760 |
| First Chance | 23 | 6 | 3,477 | 2,828 | 47 | 2,875 | 3,202 | 14 | 3,216 | 6,735 | 218 | | 103,374 |
| Flint Creek | 5 | | 66,163 | 1,350 | | 1,350 | 582,598 | | 582,598 | 65,704 | 226,261 | 852,708 | 481,656 |
| Gold Creek | | 3 | | | 78 | 78 | | 14 | 14 | | | | 2,739 |
| Henderson | 2 | 1 | 253 | 19 | 15 | 34 | 2,622 | | 2,622 | 4,500 | | | 3,326 |
| Maxville | 2 | | 197 | 64 | | 64 | 5,165 | | 5,165 | 4,714 | 3,891 | | 6,220 |
| Red Lion | 2 | | 24,181 | 4,725 | | 4,725 | 164 | | 164 | 51 | | | 165,486 |
| Rock Creek | | 3 | | | 18 | 18 | | 3 | 3 | | | | 632 |
| Stony | 2 | | 97 | 165 | | 165 | 17 | | 17 | | | | 5,786 |
| Jefferson County: | | | | | | | | | | | | | |
| Amazon | 3 | | 63 | 8 | | 8 | 478 | | 478 | 41 | 2,674 | | 716 |
| Bigfoot | 1 | | 20 | 14 | | 14 | 116 | | 116 | 255 | | | 590 |
| Boulder | 4 | | 84 | 9 | | 9 | 2,475 | | 2,475 | 265 | 21,565 | | 2,933 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cataract | 19 | 7 | 42,634 | 4,268 | 38 | 4,306 | 292,760 | 3 | 292,763 | 224,388 | 2,651,370 | 1,209,417 | 541,976 |
| Clancey | | 4 | | | 7,446 | 7,446 | | 2,540 | 2,540 | | | | 282,252 |
| Colorado | 7 | | 24,176 | 499 | | 499 | 63,640 | | 63,640 | 49,337 | 255,152 | | 75,178 |
| Elkhorn | 10 | 1 | 13,670 | 409 | 1 | 410 | 6,568 | | 6,568 | 1,653 | 32,870 | | 20,270 |
| Homestake | 4 | | 4 | 8 | | 8 | 444 | | 444 | 102 | 2,326 | | 684 |
| Lowland | | 3 | | 22 | 1,937 | 1,937 | 3,513 | 1,137 | 1,137 | 1,020 | 2,217 | | 68,530 |
| McClellan Creek | 1 | | 75 | 22 | | 22 | 396 | | 396 | 653 | | | 3,243 |
| Mitchell | 3 | | 144 | 175 | | 175 | 13,713 | | 13,713 | 21,653 | 131,587 | | 6,445 |
| Warm Springs Creek | 2 | | 14,364 | 1,692 | 1,692 | 1,692 | 10,873 | | 10,873 | 3,949 | 220,892 | | 76,260 |
| Whitehall | 10 | | 4,938 | 2,283 | | 2,283 | 464 | | 464 | 1,082 | 1,978 | | 97,832 |
| Wilson Creek | 1 | | 1,855 | 361 | | 361 | 12,324 | | 12,324 | 2,959 | 565,087 | | 13,132 |
| Judith Basin County: Barker | 1 | | 780 | 38 | | 38 | | | | | | | 35,581 |
| Lewis and Clark County: | | | | | | | | | | | | | |
| Cave Gulch | | 4 | | | 30 | 30 | | | | | | | 1,050 |
| Dry Gulch | 3 | 6 | 45,060 | 7,882 | 36 | 7,918 | 5,575 | | 5,575 | | | | 280,734 |
| Greenhorn | | 6 | | | 35 | 35 | | | | | | | 1,225 |
| Helena | 14 | 9 | 52,824 | 3,750 | 9,783 | 13,533 | 1,601 | 939 | 2,540 | 643 | 4,478 | | 475,566 |
| Lincoln | 2 | 11 | 5 | 3 | 192 | 195 | 3 | 20 | 23 | | | | 6,840 |
| Marysville | 15 | 5 | 19,563 | 5,449 | 147 | 5,596 | 14,437 | 31 | 14,468 | 7,980 | 113,435 | | 211,213 |
| Missouri River | | 8 | | | 561 | 561 | | 51 | 51 | | | | 19,668 |
| Rimini | 6 | 3 | 618 | 144 | 48 | 192 | 11,614 | 17 | 11,631 | 5,214 | 66,978 | 19,000 | 18,743 |
| Scratch Gravel | 6 | | 456 | 415 | | 415 | 591 | | 591 | 5,010 | | | 15,398 |
| Smelter | 1 | | 76,809 | | | | 9,357 | | 9,357 | | 1,419,130 | 12,126,833 | 653,417 |
| Stemple | 5 | 1 | 30,284 | 6,373 | 7 | 6,380 | 33,564 | | 33,564 | 82 | 457 | | 245,027 |
| Liberty County: Corral Creek | | 2 | | | 12 | 12 | | | | | | | 420 |
| Lincoln County: | | | | | | | | | | | | | |
| Cabinet | | 1 | 1,500 | 151 | 2 | 153 | 99 | | 99 | 51 | 457 | | 5,445 |
| Libby | | 8 | 1,509 | 185 | 297 | 482 | 348 | 17 | 365 | | 11,152 | | 17,619 |
| Sylvanite | 3 | | 14,106 | 1,764 | | 1,764 | 2,591 | | 2,591 | 245 | 15,935 | | 64,172 |
| Troy | 3 | | 142 | 1 | | 1 | 1,762 | | 1,762 | | 32,195 | 12,625 | 3,261 |
| Madison County: | | | | | | | | | | | | | |
| Havana | 1 | | 72 | 99 | | 99 | 1,830 | | 1,830 | | | | 4,648 |
| Norris | 27 | 2 | 11,187 | 8,847 | 670 | 9,517 | 12,409 | 99 | 12,508 | 1,990 | 85,109 | | 345,291 |
| Pony | 15 | | 63,794 | 8,602 | | 8,602 | 12,737 | | 12,737 | 93,531 | 456 | | 318,491 |
| Renova | 5 | | 19,835 | 18,488 | | 18,488 | 101,639 | | 101,639 | | 565 | | 712,812 |
| Rochester | 9 | | 722 | 311 | | 311 | 3,977 | | 3,977 | 1,306 | 95,087 | | 17,958 |
| Sheridan | 18 | 6 | 1,528 | 2,417 | 51 | 2,468 | 5,315 | 14 | 5,329 | 3,255 | 15,305 | | 90,848 |
| Silver Star | 10 | | 34,631 | 6,460 | | 6,460 | 6,353 | | 6,353 | 14,551 | 4,761 | | 231,850 |
| Tidal Wave | 15 | | 1,021 | 1,373 | | 1,373 | 5,544 | | 5,544 | 1,530 | 25,391 | | 52,957 |
| Virginia City | 17 | 7 | 3,363 | 1,345 | 49 | 1,394 | 13,266 | 3 | 13,269 | 194 | 5,239 | | 57,628 |
| Washington | 4 | 1 | 621 | 487 | 1,171 | 1,658 | 1,468 | 297 | 1,765 | 30 | 1,957 | | 59,264 |
| Meagher County: | | | | | | | | | | | | | |
| Atlanta Creek | | 1 | | | 19 | 19 | | 3 | 3 | | | | 667 |
| Beaver Creek | | 7 | | | 316 | 316 | | 65 | 65 | | | | 11,102 |
| Little Belt | 1 | | 14 | 24 | | 24 | 3 | | 3 | | | | 842 |
| Mineral County: Cedar Creek | 1 | 18 | 35 | 15 | 658 | 673 | | 31 | 31 | | | | 23,575 |
| Missoula County: | | | | | | | | | | | | | |
| Coloma | 8 | | 694 | 536 | | 536 | 464 | | 464 | 541 | 739 | | 19,147 |
| Copper Cliff | 1 | | 78 | 14 | | 14 | 31 | | 31 | 3,888 | | | 891 |
| Elk Creek | | 4 | | | 571 | 571 | | 51 | 51 | | | | 20,018 |
| Nine Mile | | 11 | | 415 | 129 | 129 | | 14 | 14 | | | | 4,524 |
| Wallace | 1 | | | 16 | | 16 | 2,707 | | 2,707 | 23,306 | | | 4,594 |

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*Mine production of gold, silver, copper, lead, and zinc in Montana in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore | Gold | | | Silver | | | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Park County: | | | | | | | | | | | | | |
| Crevasse | 3 | | 446 | 61 | | 61 | 31 | | 31 | | | | $2,155 |
| Emigrant Creek | | 3 | | | 213 | 213 | | 17 | 17 | | | | 7,466 |
| New World | 3 | | 440 | 362 | | 362 | 4,885 | | 4,885 | 6,204 | 22,370 | | 17,465 |
| Sheepeater | 1 | | 49,651 | 7,590 | | 7,590 | 1,284 | | 1,284 | | | | 266,480 |
| Phillips County: Little Rockies | 2 | 4 | 164,108 | 18,905 | 22 | 18,927 | 76,660 | | 76,660 | | | | 712,003 |
| Powell County: | | | | | | | | | | | | | |
| Big Blackfoot | 2 | 3 | 43 | 65 | 36 | 101 | 82 | 3 | 85 | | 304 | | 3,604 |
| Nigger Hill | 7 | 2 | 791 | 277 | 193 | 470 | 4,670 | 31 | 4,701 | 816 | 26,805 | | 20,802 |
| Ophir | | 1 | | | 69 | 69 | | 3 | 3 | | | | 2,417 |
| Pioneer | | 7 | | | 6,764 | 6,764 | | 772 | 772 | | | | 237,239 |
| Race Track Creek | 1 | | 25 | 6 | | 6 | 3 | | 3 | | | | 212 |
| Washington Gulch | 2 | 16 | 13 | 137 | 264 | 401 | 178 | 28 | 206 | 133 | 739 | | 14,215 |
| Zozell | 8 | | 3,686 | 1,800 | | 1,800 | 29,601 | | 29,601 | 41 | 48,304 | | 84,362 |
| Ravalli County: | | | | | | | | | | | | | |
| Curlew | 1 | | 18,453 | 368 | | 368 | 40,211 | | 40,211 | 33,969 | 93,130 | 484,000 | 69,720 |
| Overwich | 1 | 8 | 35 | 21 | 47 | 68 | | 3 | 3 | | | | 2,382 |
| Sanders County: | | | | | | | | | | | | | |
| Eagle | 1 | | 44,668 | 79 | | 79 | 35,377 | | 35,377 | 44,296 | 8,602,696 | 1,100,000 | 478,500 |
| Revais Creek | 3 | | 62 | 7 | | 7 | 48 | | 48 | 4,694 | | | 736 |
| Vermillion | | 2 | | | 22 | 22 | | | | | | | 770 |
| Silver Bow County: | | | | | | | | | | | | | |
| German Gulch | | 7 | | | 66 | 66 | | 14 | 14 | | | | 2,319 |
| Highland | 1 | 3 | 17,985 | 8,849 | 7 | 8,856 | 1,021 | | 1,021 | | | | 310,620 |
| Independence | 2 | | 636 | 27 | | 27 | 11,668 | | 11,668 | | | | 8,488 |
| Melrose | 4 | | 134 | 13 | | 13 | 2,475 | | 2,475 | | 6,413 | | 2,350 |
| Silver Bow Creek | | 5 | | | 48 | 48 | | 17 | 17 | | | | 1,691 |
| Summit Valley | 31 | | 1,623,736 | 6,132 | | 6,132 | 4,002,997 | | 4,002,997 | 153,709,857 | 408,565 | 1,883,417 | 17,975,180 |
| Sweet Grass County: Yellowstone River | | 1 | | | 9 | 9 | | | | | | | 315 |
| Toole County: Gold Butte | | 3 | | | 701 | 701 | | 48 | 48 | | | | 24,566 |
| Other districts [1] | 6 | 12 | 34 | 3 | 29 | 32 | 642 | | 642 | 204 | 3,152 | | 1,700 |
| Total Montana | 482 | 265 | 2,724,466 | 167,965 | 35,348 | 203,313 | 6,397,428 | 6,534 | 6,403,962 | 154,426,000 | 18,654,000 | 17,688,000 | 28,096,746 |

[1] Includes 15 districts, each having production valued at less than $200.

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In the following review by counties and mining districts, only the more important operations are mentioned. Many small producing mines and districts whose output is included in the foregoing tables are omitted.

### BEAVERHEAD COUNTY

Ermont Mines, Inc., continued regular operations in 1938 at the Ermont group of 34 claims in the Montana or Argenta district and was again the chief producer in Beaverhead County; 31,583 tons of ore were treated in the 100-ton cyanidation mill, but the output of gold decreased slightly. The remainder of the district output was crude ore shipped for smelting, including gold ore from the Goldfinch, Ground Hog, Humboldt, and Shafer mines; lead ore from the Iron Mountain, Katherine L., Midnight, Silver Horn, and Blue Moon mines; and silver ore from the Silver Horn and Trout Creek properties.

The value of the metal output from the Bannack district increased from $18,160 in 1937 to $132,430 in 1938, both placers and lode mines contributing to the gain. The Golden Leaf (Sleeping Princess) group of 21 mining claims and the 150-ton cyanidation mill at Bannack (owned by the New York Montana Mines Co.) were operated by the I. B. H. Co. during January and February, and 3,222 tons of ore were milled; later the property was acquired by the Golden Messenger Corporation, and nearly 6,000 tons of ore were cyanided during the last quarter of the year; and, in addition, lessees shipped nearly 700 tons of gold ore for smelting, chiefly from the Priscilla and Wallace claims. The Hendricks (Bannack Apex Mining Co.) and the Gold Crown (Taylor, Nelson & Knapp, Inc.) lode mines also were productive. A group of 14 placer claims on Grasshopper Creek (site of the earliest dredging operations in Montana) were acquired during 1938 by the Ralph E. Davis Syndicate; a dragline and dry-land washer were installed, and 338,372 cubic yards of gravel were treated during the season (June 24 to November 20); nearly 1,500 ounces of gold were produced—by far the most important placer production in Beaverhead County. Other producing lode mines in Beaverhead County included the Hecla mine in the Bryant district (2,654 tons of silver ore and lead ore shipped for smelting) and the Quartz Hill property in the Vipond district (699 tons of silver ore shipped for smelting).

### BROADWATER COUNTY

The placer output from the Backer district increased sharply in 1938 owing to the operation of two new dragline dredges in Confederate Gulch—Charles L. Sheridan installed power shovels and a stationary washing plant at the Boulder Bar group and treated about 125,000 cubic yards of gravel, between May 10 and November 12; and A. W. Mylroie (Fairplay Placers, Inc.) operated a dragline and washer, testing ground in Confederate Gulch, and installed heavier equipment early in 1939. The Sheriff placer at the head of Magpie Gulch also was active. Most of the lode production from the district came from the Superior mine; other producing lode mines included the Anna May, Cooper, and Satellite properties.

Gold from lode mines in the Beaver district in 1938 was more than double that in 1937; much of the gain was from the Custer mine near Winston, where the new 60-ton flotation plant was operated regu-

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larly; the mine produced 1,011 ounces of gold—nearly half of the district total. The remainder of the district output was crude ore shipped for smelting and comprised gold ore from the Agua Fria, Black Tail, Edna, Homestead, Iron Age, Sullivan, Vosburg, and Emma mines and lead ore from the Martha Washington and Stray Horse mines.

Most of the output from the Cedar Plains district came in 1938, as usual, from the Keating property operated by the C-G Gold Corporation; the mine and 100-ton flotation plant were operated regularly and the output of gold increased nearly 30 percent. The Ohio-Keating property was leased by Walter McLaren during the year, and several thousand tons of gold ore were treated in the 50-ton concentrator at the mine. The remainder of the district output included gold ore shipped for smelting from the Barnato, Black Friday, Donald Dee, Gold Coin, Hard Cash, Iron Age, Keystone, Laura Rae, and North Home mines; silver ore from the Spar property; and lead ore from the Gopher mine.

In 1938 the Marietta mine again was the chief producer in the Park district; the output comprised 266 tons of gold ore and 117 tons of lead ore shipped for smelting. Several hundred tons of ore from the Speculator mine were treated by amalgamation, and ore from the Gold Bug mine was treated by amalgamation and concentration; the remainder of the district lode output was crude ore shipped for smelting and included gold ore from the Blacksmith, Crosscut, Little Joe, Mississippi, and St. Louis mines and lead ore from the Iron Mask, Little Fannie, Park-New Era, Silver Mountain, Springhill, W. A. Clark, and West Park mines. Most of the placer output from the district came from the Wilson property on Indian Creek, operated by S. E. E., Inc.

### CASCADE COUNTY

The value of the metal output from Cascade County increased slightly in 1938 despite closing of the lead smelter at East Helena during the summer and fall; several properties suspended operations during the smelter shut-down, and others were forced to ship to lead smelters near Kellogg, Idaho, and Salt Lake City, Utah. All the output of the county came from mines near Neihart in the Montana district. The Montana Silver Queen Mining Co. again was the chief producer in the district; according to the company printed annual report, 13,494 tons of silver ore from the Big Seven group were mined and treated in the 50-ton flotation plant, and 501 tons of rich silver concentrates containing considerable gold and lead were shipped for smelting. The Florence Co. treated 10,108 tons of silver ore from the Florence mine in the 40-ton flotation plant, and Ruby Silver Mines, Inc., milled 5,125 tons of silver ore from the Benton group in a 35-ton flotation plant; silver ore from the Hartley and Silver Belt mines was also milled. The remainder of the output from the Montana district was crude ore shipped for smelting from the Commonwealth, Graham & Hollowbush, and Lucky Strike mines.

### DEER LODGE COUNTY

The value of the metal output from the Georgetown district declined 27 percent in 1938, as all the important producers reported decreases. As usual, the chief producer was the Holdfast group

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operated by Thomas H. Sheridan; 15,400 tons of gold ore were treated in the cyanidation mill, but gold from cyanide precipitates decreased. The Gold Coin Mines Co. treated several hundred tons of gold ore from the Gold Coin mine by amalgamation and several thousand tons of old tailings by cyanidation; the combined output of gold was less than in 1937. The remainder of the district output was gold ore shipped for smelting from the Isabelle and Southern Cross mines. Other production from lode mines in Deer Lodge County comprised siliceous ore shipped for smelting from the Cashier, Champion, and Independence mines in the Oro Fino district and the Cameron and Silver Heart mines in the Silver Lake district; the output of silver ore from the Silver Lake district decreased sharply, as the Silver Reef mine, an important shipper in 1937, was idle.

### FERGUS COUNTY

The value of the metal output from Fergus County in 1938 increased 35 percent over 1937, owing to regular operation of the enlarged cyanidation mill at the Barnes-King property in the North Moccasin district; the mine was operated the entire year by the North Moccasin Mines Syndicate, and the output of gold increased 1,062 ounces. A test lot of gold ore from the Dawes & Golden mine, also in the North Moccasin district, was treated by cyanidation. The remainder of the county output comprised lead ore from the Iron Chancellor mine in the Cone Butte district; silver ore from the Argentite, Silver Bell, and Silver Queen mines in the Warm Springs district; and placer gold from the Alpine and Grubstake properties in the Warm Springs district.

### FLATHEAD COUNTY

The decrease of $49,607 in the value of the metal output from Flathead County in 1938 was due almost entirely to the lower silver price prevailing, as the output of lead increased 812,000 pounds and that of silver (521,532 ounces) was only slightly less than in 1937. The Flathead mine of the Anaconda Copper Mining Co. in the Hog Heaven district was, as usual, the chief producer; the ouput comprised 15,797 tons of silver ore shipped to the Washoe smelter and 4,997 tons of silver-lead ore shipped to the lead smelter at East Helena. The remainder of the county output was silver ore from the Black Jack and Eudora mines.

### GRANITE COUNTY

The value of the metal output from Granite County declined from $2,634,839 in 1937 to $778,434 in 1938, owing chiefly to suspension of mining of zinc-lead ore at properties near Philipsburg. The Trout Mining Division of American Machine & Metals, Inc., operated the zinc-sulfide unit (Trout and Algonquin mines) during January only and produced 3,320 tons of zinc-lead ore compared with nearly 60,000 tons in 1937; the zinc-lead ore was shipped to the custom mill at Anaconda, and in addition the company shipped 7,481 tons of silver ore for smelting. The Silver Prince property of the Contact Mines Corporation was idle during July and August and operated at a reduced rate during the other 10 months of the year; the output was about one-third of that in 1937 and comprised

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3,271 tons of crude ore shipped for smelting and 1,260 tons of zinc-lead ore sent to the zinc mill at Anaconda. The Two Percent mine was operated 10 months by Taylor, Nelson & Knapp, Inc.; the output was about one-half of that in 1937 and comprised 6,732 tons of silver ore shipped for smelting and 443 tons of zinc-lead ore sent to the mill at Anaconda. The Philipsburg Mining Co. operated the Granite Bimetallic mine for 10 months and treated 43,471 tons of ore in the 165-ton flotation plant; however, the 1938 output of silver was less than half of that in 1937, owing to suspension of shipments of old tailings.

Lessees continued shipments of crude ore in 1938 for smelting from properties in the First Chance or Garnet district, but the output of gold from the district decreased 929 ounces. Most of the output again came from various claims of the Mitchell-Mussigbrod group. Other producing lode mines included the Climax, Ella May, Gold Leaf, Grant & Hartford, Lady Jane, Laddy Buck, Lynx, Nancy Hanks, Peggy Ann, Pearl, Sierra, T. H., and Tiger mines.

Operations were continued during 1938 at the Hidden Lake property in the Red Lion district; the company (Hidden Lake Venture, Inc.) treated 24,139 tons of ore in the 70-ton cyanidation mill, but the output of gold declined slightly. A car of gold ore was shipped for smelting from the Olympic mine.

Other producing lode mines in Granite County in 1938 included the Blue Bird, Brooklyn, Gold Reef, Sunday, and Tussle properties in the Boulder district; the Black Pine and Sunrise mines in the Henderson district; the Goldonna (Londonderry) and Gold Coin mines near Maxville; and the Nellie and Stevens mines in the Stony district.

Most of the placer output from Granite County in 1938 came from the Montana-Tonopah placer in the Boulder district, the Tibbits & Fowler placer on upper Gold Creek, and the New Deal placer in Henderson Gulch.

### JEFFERSON COUNTY

The value of the metal output from Jefferson County decreased 31 percent in 1938, owing chiefly to suspension of operation at the Comet property in the Cataract district. The mine and 150-ton flotation plant operated by the Basin Montana Tunnel Co. were idle during the summer, and the output of zinc-lead ore declined from 65,137 tons in 1937 to 38,170 tons in 1938; lead concentrates and iron concentrates were shipped to East Helena for smelting, and zinc concentrates were sent to the electrolytic plant at Great Falls. The Crystal mine, also in the Cataract district, was operated the entire year by Chester Bullock; the output comprised 1,869 tons of gold-silver ore shipped for smelting and 162 tons of zinc-lead ore shipped to a custom mill at Midvale, Utah. Gold ore from the Gray Lead mine was treated in a small concentrator, and the remainder of the lode output from the district was crude ore shipped for smelting from several properties, including the Boulder, Buckeye & Boston, Bullion, Idler, Jib, Minneapolis, Morning Glory, Rose, Saturday Night, Sirius, Vera, Vindicator, and Virginia mines.

There was a marked decrease in output of placer gold from the Clancey (Prickly Pear Creek, Montana City) district in 1938, owing entirely to suspension of operations on Clancey Creek by the Hum-

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phreys Gold Corporation. The company was the largest dragline operator in Montana in 1937, but operations were discontinued November 27, 1937, and the plant was dismantled. This loss was offset in part by a substantial increase in gold production by Winston Bros. Co., which operated the dragline and floating washer 11 months (the plant was idle in February) in 1938 and treated 820,424 cubic yards of gravel; in addition, the company completed erection of a Yuba connected-bucket dredge on Prickly Pear Creek south of Clancey. The new dredge is electrically powered, the digging ladder is equipped with eighty-eight 6-cubic foot buckets, and gold recovery is effected entirely by Pan-American jigs; the new plant was placed in operation August 20, 1938, and treated 587,653 cubic yards of gravel before the end of the year. Nearly all the remainder of the district output came from a dragline and washer on Dutton Ranch, which treated 43,270 cubic yards of gravel from May 25 to December 24.

The Alta property near Wickes in the Colorado district was operated in 1938 from June to December by Eathorne & Fox; the output comprised 23,748 tons of old tailings treated in a 200-ton flotation plant and 40 tons of lead ore shipped for smelting. The remainder of the district output was crude ore shipped for smelting from the Arogon, Blizzard, Blue Bird, Minah, and Minnesota mines.

The value of the metal output from the Elkhorn district decreased $84,438 in 1938 owing to suspension of operations by Elkhorn Metals, Inc. The company stopped operations at the flotation plant treating old tailings from the Elkhorn property late in 1937, and the output in 1938 was mostly clean-up material from previous operations. The J. L. Shiely Co. acquired the Peacock & Moreau property and treated about 8,000 tons of old tailings by cyanidation. Other producers in the district included the C & D, Golden Curry, Golden Moss, Klondyke, Little Goldie, Sophia, and Wildcat properties.

The placer output from the Lowland district increased markedly in 1938 owing to operation of a dragline and washing plant on Lowland Creek by Kit Carson Placers.

The Newburg Mining & Milling Co. continued operations at the Fleming property in 1938; gold ore was treated by flotation, and nearly 1,500 tons of concentrates were shipped for smelting. In addition, 316 tons of crude gold ore were produced.

Mines in the Whitehall district produced in 1938 at about the same rate as in 1937. As usual, the Golden Sunlight mine, operated by the A. O. Smith Corporation and various sublessees, was the chief producer; about 3,400 tons of gold ore were shipped for smelting. The remainder of the district output comprised gold ore from the Leah, Lucky Hit, Pay Day, Saddle Horse, Sunny Corner, and Sunnyside mines and lead ore from the Mary Lucile and Surprise properties.

The output of gold ore from the Callahan mine in the Wilson Creek (Woodland Park) district was considerably less in 1938 than in 1937. The property was operated by the Golden Age Mining Co.; the ore is treated by amalgamation and flotation.

Other producing lode mines in Jefferson County in 1938 included the Amazon & Deadwood, Bismark, and Golden Point mines in the Amazon district; the State mine in the Bigfoot district; the Ida and 0-25 mines in the Boulder district; the Babe Burns, Columbia, Crystal Hill, and Golden Valley mines in the Homestake (Pipestone) district; the Shaw mine on McClellan Creek; and the Haystack Butte, John & Jim, and Triangle mines in Mitchell Gulch.

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### JUDITH BASIN COUNTY

Lessees continued operations in 1938 at the property of Glendennin Mines, Inc., in the Barker district; the output comprised 780 tons of silver-lead ore shipped for smelting.

### LEWIS AND CLARK COUNTY

The value of the metal output from Lewis and Clark County in 1938 decreased 33 percent from 1937, owing chiefly to suspension of operations at the slag-fuming plant of the Anaconda Copper Mining Co. at East Helena. The plant, which treats current slag from the lead smelter of the American Smelting & Refining Co., was closed from July 5 to November 3, and the output of zinc-lead fume decreased markedly.

The Golden Messenger Corporation operated the 125-ton cyanidation mill at York (Dry Gulch district) at capacity in 1938, treating about 45,000 tons of ore compared with 35,033 tons in 1937; the output of gold increased 2,908 ounces and accounted for the marked increase in value of the district output. Lessees at the Federal Gold property shipped gold ore for smelting.

The Spring Hill mine near Helena was operated in 1938 by the Montana Consolidated Mines Corporation from January 1 to June 29, when operations were suspended owing to closing of the smelter at East Helena; the 300-ton flotation plant treated 52,414 tons of ore from the Spring Hill mine in 1938 compared with 89,652 tons in 1937, and the output of gold decreased proportionately. At the end of the year a 25-ton cyanidation plant to treat flotation concentrates from the Spring Hill mill was under construction; the new plant was placed in operation early in 1939. The remainder of the output from lode mines in the Helena district was crude ore shipped for smelting from several properties, including the Court House, Eula (Homestake), Jupiter, Lockey, Lone Star, Morelight, San Juan, Sky, Twylight, and Whitlatch mines. Porter Bros. Corporation operated the Yuba dredge (equipped with eighty-five 6-cubic foot buckets) north of Helena the entire year, treating 1,809,812 cubic yards of gravel (about the same amount as in 1937), but the output of gold decreased 12 percent.

Placer production from the Lincoln district decreased in 1938, as the output from the Stonewall placer was much less than in 1937. The Blue Cloud Mining Co. was organized in July to operate a dragline and washer at the Blue Cloud placer; 1,058 cubic yards of gravel were treated during 1938. Other producing placers included the Bloom & Old Billy Williams and Harvey properties; test lots of gold ore were shipped for smelting from the Gold Dollar and Sun Rise lode mines.

The value of the metal output of the Marysville (Ottawa) district increased from $110,205 in 1937 to $211,213 in 1938, owing chiefly to operations at the Empire property by the Rex Mining Co.; gold ore from the mine was treated in a small flotation plant, and lead concentrates, unusually rich in gold, were shipped for smelting. The J. C. Archibald Co. was formed during the year, and from August 1 to October 23 the company treated 10,720 tons of old tailings from the Bald Butte property by cyanidation. Lessees shipped 2,430 tons of

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gold ore for smelting from the Drumlummon property, and the Bald Butte Lease shipped 961 tons of gold ore from the Bald Butte mine. The remainder of the district lode ouput comprised gold ore shipped for smelting from the Big Ox, Excelsior, Meagher, North Star, Penobscot, Piegan-Gloster, Raymond & Zigmund, and Shannon mines; a little gold ore from the Climax mine, treated by amalgamation; and old tailings from two properties, treated by cyanidation. Most of the district placer output came from a dragline and washer on Silver Creek operated by J. W. Merz; the plant operated from July 11 to September 12 and treated about 40,000 cubic yards of gravel.

The Perry-Schroeder Mining Co. in 1938 completed erection of a new Yuba dredge on Eldorado Bar in the Missouri River (Hauser Lake) district; the dredge, which is equipped with jigs and has a digging ladder equipped with ninety 6-cubic foot buckets, was placed in operation November 27 and treated 75,604 cubic yards of gravel by the end of the year. In addition to gold and silver the dredge also recovers industrial sapphires. Despite operation of the new dredge the value of the placer output from the district decreased owing to closing of the Gruell Bar plant by the Lorraine Placer Mining Co.; other producing placers in 1938 included the Golden Ring & Sunset, Mable, and Ox Bow properties.

The value of the metal output of the Rimini district in 1938 decreased $46,536. Declining prices of lead and zinc caused the closing of the Montana Lead and Little Lily properties at Rimini in August; the output from the Montana Lead property was 303 tons of ore compared with nearly 2,100 tons in 1937; no production was reported at the Little Lily mine, operated by the Callahan Zinc-Lead Co. Other producers at Rimini included the Anna May & Broadway, Aurora, Kelley, and Peerless Jennie mines.

In 1938 the Franklin mine again was the chief producer in the Scratch Gravel district; lessees shipped 323 tons of gold ore from the property, a decrease from 520 tons in 1937. Other producers in the district included the Enakops, Gold Crown, Nettie, and Umatilla mines.

The value of the metal output from the Stemple (Wilborn) district in 1938 decreased 18 percent owing to lessened output from the Gould mine; the mine and 80-ton cyanidation mill were operated the full year by the Standard Silver-Lead Mining Co., and nearly 30,000 tons of gold ore and old tailings were milled, but the output of gold declined nearly 700 ounces and silver nearly 20,000 ounces. Other producers in the district included the American Boy (North Gould Mining Co.), Hubbard, Irma, and Silver Bell mines.

### LIBERTY COUNTY

About 1,000 cubic yards of gravel from the Sweetgrass Placers in the Corral Creek district were treated in a washing plant during 1938; a little placer gold was recovered at the Hatch property also.

### LINCOLN COUNTY

The Gold Hill property in the Cabinet district was operated a short time early in 1938 by the Viking Mining Co., and 1,500 tons of gold ore were treated in a small amalgamation and gravity-concentration plant.

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The New Deal (Tip Top) mine in the Libby district was operated in 1938 by lessees; several hundred tons of ore was treated by amalgamation and concentration. A car of lead ore was shipped for smelting from the Snowshoe mine 18 miles southeast of Libby. Most of the district placer output came from the power-shovel and sluicing plant of the Liberty Placer Mining Co.; other producing placers included the Nuggett (Stone Mining Co.), Hard Times, and Libby properties.

Several thousand tons of gold ore from the Sylvanite (Keystone) property were treated by amalgamation and flotation in 1938, but the output of gold decreased more than 300 ounces. A little gold ore from the Black Diamond property (Troy Development Association) was treated by amalgamation and concentration, and lead ore from the Lead Cliff mine (mined in 1937) was shipped in 1938 for smelting.

Zinc-lead ore from the Liberty Metals and Blue Creek properties in the Troy district was sent in 1938 to the Hercules custom plant at Wallace, Idaho, for milling.

### MADISON COUNTY

The value of the metal output from lode mines and placers in Madison County in 1938 increased 57 percent. There were increases in the Norris, Pony, Renova, Sheridan, Silver Star, Tidal Wave, and Washington districts; the output from Rochester and Virginia City decreased.

Mines in the Norris district (Upper and Lower Hot Springs and Norwegian) yielded metals valued at $345,291 in 1938, an increase of $99,817 over 1937. Most of the increase was from the Revenue mine in the Upper Hot Springs section, operated by the Revenue Mine Developing Group, Inc. A new 75-ton cyanidation plant at the mine was placed in operation in October and treated 6,400 tons of ore during the remainder of the year; in addition, the company shipped several hundred tons of gold ore for smelting. The Boaz mine, operated by the Boaz Lease, was again the largest producer in the district, it shipped nearly 1,800 tons of rich gold ore for smelting, a slight decrease from 1937. There was a marked increase in gold ore shipped from the Lexington mine, but that from the Josephine mine decreased. Gold ore also was shipped for smelting from the Artic, Betty May, Billy & Helen, Comstock, Eldorado, Elephant's Tail, Emperor, Galena, Grubstake, Golden Treasure, Minnie, Monitor, Montida, Pauline, Pulverizer, Rose Bud, Roy B, and Valdez mines. The floating dredge on Norwegian Creek was operated by Homer Wilson from June 25 to December 31; the output of gold increased more than 400 ounces.

Increases were reported in output in 1938 at both the Mammoth and Atlantic-Pacific properties. The Liberty Montana Mines Co. operated the Mammoth mine the full year and treated 30,862 tons of gold ore in the flotation plant; 1,932 tons of gold-copper concentrates were shipped, and the output of gold increased more than 1,400 ounces. Montana Southern Mining Co. treated 31,820 tons of gold ore from the Atlantic-Pacific mine by flotation and shipped 1,462 tons of gold concentrates for smelting; the mill was idle from July 1 to July 19, but the output of gold from the property increased more than 700 ounces. Lessees operated for 10 months at the Keystone-Strawberry group and treated 750 tons of gold ore by amalgamation

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and concentration. The remainder of the output from the Pony district comprised gold ore from the Bozeman mine, treated by amalgamation; gold ore shipped for smelting from the Arizona, Ben Harrison Fraction, Chile, Galena, Little King, Lone Wolf, Whip-poor-will, and White Pine mines; and clean-up material from the Boss Tweed & Clipper, Getchell, and Stone mills.

The value of the metal output from the Renova district in 1938 increased $434,570 owing to marked increase in shipments of gold ore by the West Mayflower Mining Co. (Anaconda Copper Mining Co.); the company produced 19,229 tons of rich gold ore, compared with 13,134 tons in 1937, and the mine became the largest producer of gold in Montana. Other producers in the district were the Blue Bird, Colorado, Florence, and Mary Ingabar mines.

The output from the Rochester (Rabbit) district in 1938 was less than half of that in 1937, as shipments of lead ore from the Commonwealth mine were only 124 tons compared with nearly 800 tons in 1937. Other producers included the Half Sole, Delilia, Hidden Treasure, Jack Rabbit, Long Shift, Pasadena, and Shoemaker mines.

The value of the metal output from the Sheridan district in 1938 was more than three times that in 1937 owing to increased shipments of gold ore from the Uncle Sam (Homestake) mine operated by the Sheridan Gold Mining & Milling Co. and the Fairview group operated by Fairview Gold Mines, Inc. Crude ore was shipped also for smelting from the Buckeye, Cousin Jack, Cousin Jennie, Ella Jay, Goldsmith, Jay Bird, Red Bird, Red Pine, Sarge Hall, and Sunbeam mines; in addition, gold ore from the Goldsmith, Red Pine, and Columbia mines was treated in small amalgamation mills.

Victoria Mines, Inc., operated the 100-ton cyanidation plant at the Broadway property throughout 1938 and treated 32,592 tons of ore and old tailings, a marked increase over the 1937 output; in addition, the company shipped 193 tons of gold ore for smelting. There was also a marked increase in gold ore shipped for smelting from the Golden Rod property; the mine was operated the full year by the Golden Rod Mining Co., and more than 1,000 tons of rich gold ore were shipped. The Green Campbell Mining Co. treated several hundred tons of ore in a small cyanidation plant and shipped a car of gold ore for smelting. The remainder of the output from the Silver Star district comprised gold ore shipped for smelting from the Edgerton, Governor Hayes, Jumbo, Moonlight, and Ohio mines.

The value of the metal output from the Tidal Wave district in 1938 increased $32,491 owing to increased shipments of gold ore from the High Ridge mine; the property was operated by a lessee, and 262 tons of rich gold ore were shipped for smelting. Lessees treated 400 tons of ore from the Agitator mine in a small amalgamation and concentration mill, and crude ore was shipped for smelting from the B & H, Carolina, Eagle, Eleanor & Little Goldie, Ella, Granger, Isabella, Keynote, Mountain View, Pollinger, and Smith mines.

The value of the metal output from the Virginia City district in 1938 decreased $173,819. Gold from placer mines decreased from 2,653 ounces in 1937 to 49 ounces in 1938 owing to the closing in June 1937 of the large dragline and washing plant of the Humphreys Gold Corporation. Gold from lode mines also decreased, as the output from the Marietta mine was less than one-sixth of that in 1937, when more than 12,000 tons of ore were milled. Gold ore from the

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Winnetka mine was treated by amalgamation and concentration. Most of the remainder of the district output was crude ore shipped for smelting from the Alameda, Bamboo Chief, Bartlett, East & West Mapleton, Easton-Pacific, Hansen, High Up, Homestake, Prospect, St. John & Gypsy, Silver Bell, and Winnetka mines.

The Gold Creek Mining Co. completed in 1938 the erection of a floating dredge at the Washington Bar property on Meadow Creek. The new dredge has a digging ladder of seventy-six 4½-cubic foot buckets and handled 284,597 cubic yards of gravel between August 1 and December. Output from lode mines in the Washington district comprised gold ore from the Missouri-McKee mine, treated by amalgamation and concentration, and crude ore shipped for smelting from the Highland Lady, Lehigh, Missouri-McKee, and Twin Lakes mines.

### MEAGHER COUNTY

A ¾-cubic yard dragline and sluicing plant on Thomas Creek was operated in 1938 by the T. C. Mine from June 19 to September 2 and treated 20,870 cubic yards of gravel. A dragline and washer was operated also in Benton Gulch at Watson by W. R. Deem. Other producing placers in the Beaver Creek district included the Bonanza, Eldorado, Sawmill, and Watson properties. A little gold ore was shipped for smelting from the Beverly Hills property in the Little Belt district.

### MINERAL COUNTY

Placer gold output from the Cedar Creek district in 1938 decreased 336 ounces. Fred Byram Placers, Inc., was again the chief producer; the company operated a dragline and washer at the Calumet placer from July 15 to November 14 and treated 9,500 cubic yards of gravel. Other producing placers included the C. B. & Q., Cedar Creek, Dakota, Dr. Eddy & Nugget, McFarland, Meadow Creek, No Name & Blacktail, Ohio Gulch, Oregon Creek, Stemwinder, Stockholm, Sunlight, Swastika, and Windfall properties. A car of gold ore was shipped for smelting from the Last Chance mine near Superior.

### MISSOULA COUNTY

The value of the metal output from the Coloma district in 1938 decreased slightly. The output was gold ore; it included 400 tons from the Mountain View mine, treated by amalgamation and flotation, and crude ore shipped for smelting from the Arm & Hammer, Clemantha, Dandy, Dixie, I. X. L., Mammoth, and Northern Star mines.

The output from placer mines in the Elk Creek district in 1938 increased markedly owing to operation of a dragline and washer by Norman Rogers Mining Co. on Elk Creek 7 miles southeast of Greenough.

The output from the Nine Mile district was placer gold and silver, chiefly from the Boyd, Hard Chance, Oro, and Slide placers.

The value of the metal output of the Wallace district in 1938 decreased $19,635. Copper ore from the Hidden Treasure mine decreased from nearly 1,600 tons in 1937 to 415 tons in 1938.

### PARK COUNTY

The value of the metal output from Park County in 1938 decreased $213,276 owing to idleness at the New Year's Gift mine in the New World district and to the smaller output from the Jardine mine in the

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Sheepeater district. The Jardine Mining Co. treated about 50,000 tons of ore in the 40-stamp amalgamation and flotation mill, but the output of gold was about 2,400 ounces less than in 1937. Other producing lode mines in the county included the Columbus and Snowshoe mines in the Crevasse district and the Homestake and Republic mines in the New World district. Most of the county placer output came from small-scale operations at the Emigrant and Hefferlin properties in Emigrant Gulch.

### PHILLIPS COUNTY

The two cyanidation mills in Phillips County were operated continuously in 1938; a larger tonnage of ore was treated than in 1937, but the output of gold decreased at each plant. The Ruby Gulch Mining Co. treated 109,925 tons of ore in the 300-ton plant at Zortman and also shipped 602 tons of rich gold ore for smelting, but the output of gold from the property declined 1,320 ounces; development totaled 5,942 feet, and dividends of $55,000 were paid during the year. The Little Ben Mining Co. treated 53,581 tons of gold ore from the August mine in the 100-ton plant compared with 45,209 tons in 1937, but gold in cyanide bullion decreased about 2,400 ounces; development totaled 4,817 feet.

### POWELL COUNTY

The output from placer mines in the Pioneer (Gold Creek) district in 1938 increased slightly. The Pioneer Placer Dredging Co. operated the floating dredge, equipped with seventy-eight 9-cubic foot buckets, on Gold Creek the entire year and treated 1,866,840 cubic yards of gravel from which 6,612 ounces of gold and 761 ounces of silver were recovered, an increase of 308 ounces of gold over 1937. Other producing placers in the district included the Cold Spring, Findasha & Falls, Murray Patent, Nellie B, North Fork, and Yam Hill properties.

The value of the metal output from the Zozell (Emery) district in 1938 decreased $54,493 owing to closing of the Bonanza mine. Lessees shipped 1,366 tons of gold ore from the mine compared with 5,309 tons in 1937, and the output of gold declined 1,330 ounces. Other producing mines in the district included the Argus, Blue Eyed Maggie, Emery, Emma Darling, Hidden Hand, and Sabbath Day properties, all producers of crude ore shipped for smelting.

The Hattie M. & Annie R. property near Elliston (Nigger Hill district) was operated by Newman Bros.; gold ore was treated in a small amalgamation and concentration mill, and 159 tons of gold ore were shipped for smelting. Gold ore from the Big Dick mine also was treated by amalgamation and concentration, and ore was shipped for smelting from the Hi-Ore & Hi-Way, Lilly, Hub Camp, and Ontario mines. Considerable placer gold was produced by the Duclo Mining Co. at a dragline plant in Reinig Gulch.

The placer output from the Washington Gulch district in 1938 decreased markedly owing to the closing in October 1937 of the dragline plant at the Fontana property. The C. A. Wagner Construction Co. installed a dragline and washing plant in Buffalo Gulch and treated 35,967 cubic yards of gravel between September 1 and November 9. Other producing placers in the district included the Beatrice, Cornucopia, Gold Bar, Old Shoe, Rietz, and Whitetail properties. Small lots of rich gold ore were shipped from the Grey (Great States Gold Mining Co.) and Mascotte lode mines.

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Other producing mines in Powell County in 1938 included the Hill Top and Sweepstake & Sunrise lode mines near Helmville (Big Blackfoot district), the Dark Horse lode mine in the Race Track Creek district, and Harps Placer in Ophir Gulch.

### RAVALLI COUNTY

The Hamilton Victor Reduction Co. operated the 100-ton flotation plant at the Curlew property for 7 months in 1938. Nearly 18,000 tons of old tailings were treated in the mill, and lead concentrates and zinc concentrates were shipped; in addition, the company shipped about 600 tons of gold ore for smelting. Gold ore from the Washington mine in the Overwich district was treated by amalgamation. A test lot of gold ore from the White Cloud mine in the Eight Mile Creek district was shipped for smelting. Most of the placer output from Ravalli County came from the Hogue property in the Overwich district.

### SANDERS COUNTY

The American Smelting & Refining Co. operated the Jack Waite mine in the Eagle district throughout 1938. This property extends over the State line into Shoshone County, Idaho, and production was reported from both States. The output from the Montana section comprised 43,390 tons of ore treated in the flotation plant at Duthie, Idaho, and 1,278 tons of rich lead ore shipped for smelting. Output of all five metals decreased slightly, and lower average sales prices resulted in a marked decrease in total value of the district metal output. The Green Mountain Mining Co. operated the Drake (Dixon) property in the Revais Creek district in 1938 from August until the end of the year; shipments of copper ore totaled 42 tons, a decrease from more than 600 tons in 1937. A little copper ore was shipped from the New Deal mine also. The placer output from the Vermillion district came from the Mammy Lou & Driftwood and Ogoma properties.

### SILVER BOW COUNTY

The following table gives the output of mines in Silver Bow County, which includes the Butte or Summit Valley district, in 1937 and 1938 and the total from 1882 (the first year for which detailed records are available) to the end of 1938.

*Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1937–38, and total, 1882–1938, in terms of recovered metals* [1]

| Year | Mines producing | Ore | Gold (lode and placer) | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| 1937 | 84 | 3,684,972 | 20,521 | 8,071,519 | 287,757,000 | 11,560,000 | 44,066,000 | $45,326,482 |
| 1938 | 55 | 1,642,491 | 15,147 | 4,018,192 | 153,709,857 | 414,978 | 1,883,417 | 18,300,823 |
| 1882–1938 [1] | | [2] | 1,876,183 | 493,902,691 | [3] 5,656,539 | [3] 193,539 | [3] 1,415,905 | 2,305,362,336 |

[1] Grand total, 1882–1937, inclusive, given in Minerals Yearbook, 1938, p. 356, is in error. Total in this table includes corrections. No annual figures have been changed.
[2] Figures not available.
[3] Short tons.

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*Butte or Summit Valley district.*—The Anaconda Copper Mining Co. operated its copper mines at Butte at a reduced rate throughout 1938, continuing a curtailment that was begun in the last quarter of 1937. Copper ore sent to the copper concentrator at Anaconda decreased from 3,068,665 tons in 1937 to 1,561,186 tons in 1938; the sand-leaching plant at Anaconda was not operated in 1938 (it treated 307,014 tons of old sand tailings in 1937). Copper ore shipped direct to the smelter increased from 35,639 to 45,161 tons, but mine-water precipitates decreased from 6,298 to 4,045 tons. Net copper produced from copper ores decreased 46 percent from 1937, gold 64 percent, and silver 42 percent. Development at all copper claims totaled 112,032 feet compared with 180,181 feet in 1937. The zinc mines of the Anaconda Copper Mining Co. at Butte were closed in the summer of 1937 and were not in production during 1938; limited development (9,614 feet) was continued at the zinc properties, and the output of zinc-lead ore (entirely from development) was only 2,638 tons in 1938, a decrease from 119,536 tons in 1937, resulting in marked decreases in the output of all five metals. The Emma mine (owned by the Butte Copper & Zinc Co. but operated under lease by the Anaconda Copper Mining Co.) was closed January 20, 1938, and only 7,208 tons of zinc-lead ore were produced compared with 107,428 tons in 1937. The zinc concentrator at Anaconda also was closed most of the year, and custom shippers of zinc-lead ore, chiefly those at Philipsburg, were forced to suspend production. The Green Copper property at Butte was operated by a lessee who shipped 618 tons of copper ore to the copper concentrator at Anaconda and 48 tons of zinc-lead ore to the Comet mill near Basin for milling. All the remainder of the district output was crude ore shipped for smelting from the Alice, Amy Silversmith, Anna, Black Rock, Eveline, Fayal, Glengary, Gulch, Hawkeye, Illinois, Josephine, Jumbo, Lavena, Magna Charta, Magnolia, Minnie Jane, Pittsmont, Sailor's Dream, Saukie, and Valdemere mines.

The Butte Highlands Mining Co. operated throughout 1938 at the Highlands (Tilton) group in the Highlands district southeast of Butte. The 75-ton cyanidation mill, placed in operation in November 1937, treated 17,985 tons of ore and old tailings in 1938 (a marked increase from the 2,543 tons treated in 1937), and the output of gold increased from 862 ounces to 8,849 ounces.

The remainder of the output from lode mines in Silver Bow County in 1938 comprised ore shipped for smelting from the Goldflint and Nettie mines in the Independence district and the Blue Bird, O. K., and Way Up mines in the Melrose district.

### TOOLE COUNTY

All the output from Toole County in 1938 came from placers in Eclipse Gulch; about 76,300 cubic yards of gravel were treated by Gold Butte Placers in a dragline and washing plant.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

**(MINE REPORT)**

By CHARLES WHITE MERRILL AND H. M. GAYLORD [1]

## SUMMARY OUTLINE


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Nevada's mining industry in 1938 was characterized by a halving of the combined value of the output of the base metals—copper, lead, and zinc—compared with 1937. The value of gold production increased slightly and was greater than in any year since 1915; it was the State's most valuable mineral product in 1938. The total value of the gold, silver, copper, lead, and zinc produced in Nevada was $23,529,064 in 1938 compared with $34,617,056 in 1937, a decline of 32 percent. Gold increased 5 percent in both quantity and value. The other metals decreased, as follows: Silver, 10 percent in quantity and 25 percent in value; copper, 38 and 50 percent, respectively; lead, 50 and 61 percent, respectively; and zinc, 37 and 54 percent, respectively. Of the total value of the five metals in 1938, gold accounted for 44 percent, copper 38 percent, silver 12 percent, zinc 4 percent, and lead 2 percent.

During 1938 White Pine County continued to be the largest contributor to the nonferrous metal wealth of the State; it ranked first in output of copper, second in gold, and third in silver. Esmeralda County was the leading producer of the two precious metals and Lincoln County of both zinc and lead.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price for all grades of primary metal sold by producers. [4] $0.64646464.

[1] The assistance of L. F. Janssen is acknowledged.



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*Mine production of gold, silver, copper, lead, and zinc in Nevada, 1934–38, and total, 1859–1938, in terms of recovered metals*

| Year | Mines producing [1] | | Ore, old tailings, etc. (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 635 | 160 | 2,899,782 | 144,275.17 | $5,042,417 | 3,057,114 | $1,976,316 |
| 1935 | 706 | 149 | 4,392,819 | 188,031.00 | 6,581,085 | 4,393,426 | 3,157,775 |
| 1936 | 661 | 119 | 6,584,138 | 286,370.00 | 10,022,950 | 5,068,786 | 3,925,775 |
| 1937 | 682 | 117 | 7,565,466 | 281,332.00 | 9,846,620 | 4,864,750 | 3,762,884 |
| 1938 | 795 | 130 | 5,880,021 | 296,434.00 | 10,375,190 | 4,355,471 | 2,815,658 |
| 1859–1938 [2] | | | [3] | 23,663,592.00 | 506,787,396 | 565,384,135 | 523,522,126 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 41,611,119 | $3,328,890 | 21,981,874 | $813,329 | 27,880,790 | $1,198,874 | $12,359,826 |
| 1935 | 74,266,000 | 6,164,078 | 25,352,000 | 1,014,080 | 31,072,000 | 1,367,168 | 18,284,186 |
| 1936 | 141,392,000 | 13,008,064 | 21,424,000 | 985,504 | 26,954,000 | 1,347,700 | 29,289,993 |
| 1937 | 149,206,000 | 18,053,926 | 18,694,000 | 1,102,946 | 28,472,000 | 1,850,680 | 34,617,056 |
| 1938 | 92,338,000 | 9,049,124 | 9,358,000 | 430,468 | 17,880,000 | 858,624 | 23,529,064 |
| 1859–1938 [2] | [4] 1,241,532 | 370,288,746 | [4] 495,601 | 52,863,277 | [4] 225,645 | 31,055,264 | 1,484,516,809 |

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[2] Compiled by Chas. W. Henderson, supervising engineer, field offices, Denver, Colo. From 1904 (when first satisfactory annual canvass of mine production was made) to 1938, inclusive, the output was as follows: Gold, 11,836,715.51 ounces, valued at $262,304,163; silver, 276,971,286 ounces, $186,363,903; copper, 1,239,606 short tons, $369,642,118; lead, 257,810 short tons, $30,226,715; zinc, 225,645 short tons, $31,055,264; total value, $879,592,163.

[3] Figures not available.

[4] Short tons.

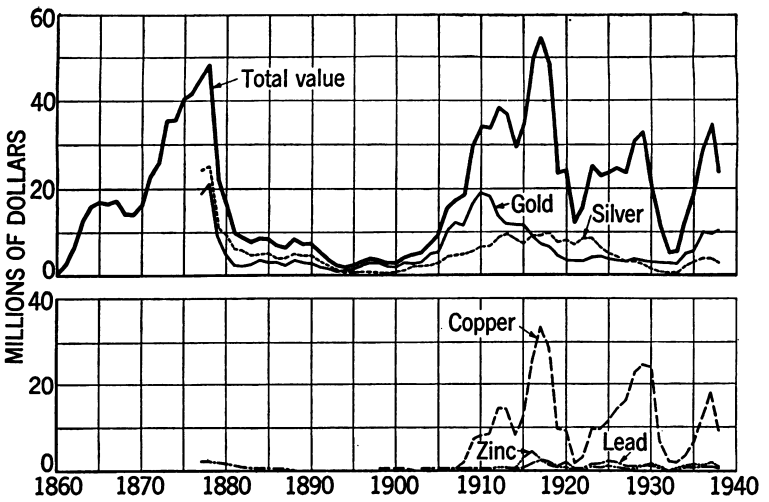


FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada, 1860–1938.

*Gold.*—Over three-fourths of the recoverable gold output of Nevada in 1938 was derived from dry ores, chiefly straight gold ore; copper ore accounted for much of the remainder, and placer mining yielded

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4 percent of the total. Ten companies in Nevada produced 50 percent of the State total gold; the following table lists these producers in order of output.

*Ten leading gold producers in Nevada in 1938, in order of output*

| Mine | District | County | Rank in 1937 | Operator | Source of gold |
|---|---|---|---|---|---|
| Mary | Silver Peak | Esmeralda | 4 | Black Mammoth Consolidated Mining Co. | Gold ore. |
| Emma Nevada | Robinson | White Pine | 2 | Consolidated Coppermines Corporation and lessees. | Copper ore.[1] |
| Getchell | Potosi | Humboldt | (2) | Getchell Mine, Inc. | Gold ore. |
| Ruth and Copper Flat Pit. | Robinson | White Pine | 1 | Nevada Consolidated Copper Corporation. | Copper ore. |
| Weepah | Lone Mountain | Esmeralda | 3 | Weepah Nevada Mining Co. | Gold ore.[3] |
| Overman | Comstock | Storey | 11 | Consolidated Chollar Gould & Savage Mining Co. | Gold ore. |
| Chiquita | Yellow Pine | Clark | 9 | Chiquita Mining Co., Ltd. | Do. |
| Mizpah | Tonopah | Nye | 8 | Lessees of The Tonopah Mining Co. of Nevada. | Gold-silver ore. |
| Penelas | Phonolite | do | 13 | Penelas Mining Co | Gold ore. |
| Sierra Nevada | Comstock | Storey | 22 | Sierra Nevada, Ltd | Do. |

[1] Gold-silver ore and lead ore also source of small part of the gold.
[2] Production started Mar. 1, 1938.
[3] Approximately three-fourths ore and one-fourth old tailings.

*Silver.*—Of the 10 leading producers of silver in Nevada in 1938 (listed in the following table), only 2 derived their output from straight silver ore; at the other 8 mines silver was a byproduct of gold-silver, zinc-lead, and copper ores. These 10 mines produced 66 percent of the State total.

*Ten leading silver producers in Nevada in 1938, in order of output*

| Mine | District | County | Rank in 1937 | Operator | Source of silver |
|---|---|---|---|---|---|
| Nivloc | Silver Peak | Esmeralda | 5 | Desert Silver, Inc | Silver ore. |
| Mizpah | Tonopah | Nye | 1 | Lessees of The Tonopah Mining Co. of Nevada. | Gold-silver ore. |
| Emma Nevada | Robinson | White Pine | 10 | Consolidated Coppermines Corporation and lessees. | Copper ore.[1] |
| Pioche No. 1 | Pioche | Lincoln | 2 | Combined Metals Reduction Co. | Zinc-lead and lead ores. |
| Tonopah Belmont | Tonopah | Nye | 4 | Tonopah Belmont Development Co., lessees, and sublessees. | Gold-silver ore. |
| Bristol Silver | Jack Rabbit | Lincoln | 12 | Bristol Silver Mines Co | Silver ore. |
| Overman | Comstock | Storey | 13 | Consolidated Chollar Gould & Savage Mining Co. | Gold ore. |
| Crown Point | do | do | 11 | Sutro Tunnel Coalition, Inc. | Gold-silver ore. |
| Ruth and Copper Flat Pit. | Robinson | White Pine | 6 | Nevada Consolidated Copper Corporation. | Copper ore. |
| Nevada Standard | Cherry Creek | do | 9 | Nevada Standard Mining Corporation. | Gold-silver ore. |

[1] Gold-silver ore and lead ore also source of small part of the silver.

*Copper.*—Almost 98 percent of the recoverable copper production of Nevada in 1938 came from mines operated by the following companies: Nevada Consolidated Copper Corporation working the Ruth

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mine at Ruth and the open pit at Copper Flat and the Consolidated Coppermines Corporation working the Emma Nevada mine (all in the Robinson district of White Pine County), and the Mountain City Copper Co. working the Mountain City mine in the Cope district of Elko County. The sharp decrease in total output from 1937, the all-time record year for the State, was the result of a production-curtailment program at the three leading copper-producing properties.

*Lead.*—Two-thirds of the recoverable lead output of Nevada in 1938 was derived from zinc-lead ore mined by the Combined Metals Reduction Co. at the Pioche No. 1 mine in the Pioche district of Lincoln County. The Bristol Silver Mines Co. operating in the Jack Rabbit district of Lincoln County and the Yellow Pine Development Co. in the Yellow Pine district of Clark County recovered much smaller, but substantial, quantities of lead. The outstanding cause of the great decline in the lead production of Nevada in 1938 was suspension of operations at the Tybo mine in the Tybo district of Nye County, upon exhaustion of its known ore bodies late in 1937; the lower average lead price in 1938 was also an adverse factor.

*Zinc.*—Following the closing of the Tybo mine late in 1937, the Pioche No. 1 mine of the Combined Metals Reduction Co. was the only large producer of zinc in Nevada; it was the source of over nine-tenths of the recoverable zinc output of the State in 1938. The only other production of any size came from the property of the Yellow Pine Development Co. in the Yellow Pine district of Clark County.

## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, by counties, in terms of recovered metals*

| County | Mines producing [1] | | Gold | | | | | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lode | | Placer | | Total | | | |
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value | Fine ounces | Value | Fine ounces | Value |
| Churchill | 34 | 1 | 1,517 | $53,095 | 1 | $35 | 1,518 | $53,130 | 76,736 | $49,607 |
| Clark | 54 | 1 | 20,051 | 701,785 | 13 | 455 | 20,064 | 702,240 | 127,067 | 82,144 |
| Douglas | 6 | 1 | 29 | 1,015 | 6 | 210 | 35 | 1,225 | 45 | 29 |
| Elko | 54 | 5 | 6,254 | 218,890 | 80 | 2,800 | 6,334 | 221,690 | 119,451 | 77,221 |
| Esmeralda | 42 | 11 | 61,064 | 2,137,240 | 147 | 5,145 | 61,211 | 2,142,385 | 848,775 | 548,703 |
| Eureka | 32 | 11 | 8,585 | 300,475 | 324 | 11,340 | 8,909 | 311,815 | 139,564 | 90,223 |
| Humboldt | 45 | 9 | 28,166 | 985,810 | 378 | 13,230 | 28,544 | 999,040 | 21,138 | 13,665 |
| Lander | 49 | 17 | 7,416 | 259,560 | 6,033 | 211,155 | 13,449 | 470,715 | 128,988 | 83,386 |
| Lincoln | 35 | | 7,663 | 268,205 | | | 7,663 | 268,205 | 638,768 | 412,941 |
| Lyon | 49 | 4 | 10,506 | 367,710 | 63 | 2,205 | 10,569 | 369,915 | 37,911 | 24,508 |
| Mineral | 86 | 3 | 6,090 | 213,150 | 41 | 1,435 | 6,131 | 214,585 | 64,543 | 41,725 |
| Nye | 100 | 37 | 28,607 | 1,001,245 | 3,913 | 136,955 | 32,520 | 1,138,200 | 808,689 | 522,789 |
| Ormsby | 1 | | 3 | 105 | | | 3 | 105 | 4 | 3 |
| Pershing | 60 | 18 | 3,215 | 112,525 | 777 | 27,195 | 3,992 | 139,720 | 47,881 | 30,953 |
| Storey | 36 | 2 | 39,182 | 1,371,370 | 99 | 3,465 | 39,281 | 1,374,835 | 583,645 | 377,306 |
| Washoe | 26 | 3 | 973 | 34,055 | 97 | 3,395 | 1,070 | 37,450 | 5,528 | 3,574 |
| White Pine | 86 | 7 | 54,154 | 1,895,390 | 987 | 34,545 | 55,141 | 1,929,935 | 706,738 | 456,881 |
| Total, 1937 | 795 | 130 | 283,475 | 9,921,625 | 12,959 | 453,565 | 296,434 | 10,375,190 | 4,355,471 | 2,815,658 |
| | 682 | 117 | 271,569 | 9,504,915 | 9,763 | 341,705 | 281,332 | 9,846,620 | 4,864,750 | 3,762,884 |

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

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*Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, by counties, in terms of recovered metals*—Continued

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Churchill | | | 6,000 | $276 | | | $103,013 |
| Clark | 28,000 | $2,744 | 572,000 | 26,312 | 1,052,000 | $50,496 | 863,936 |
| Douglas | | | | | | | 1,254 |
| Elko | 13,306,000 | 1,303,988 | 302,000 | 13,892 | 8,000 | 384 | 1,617,175 |
| Esmeralda | 4,000 | 392 | 64,000 | 2,944 | | | 2,694,424 |
| Eureka | 4,000 | 392 | 258,000 | 11,868 | | | 414,298 |
| Humboldt | 4,000 | 392 | 32,000 | 1,472 | | | 1,014,569 |
| Lander | 800,000 | 78,400 | 84,000 | 3,864 | | | 636,365 |
| Lincoln | 1,124,000 | 110,152 | 7,512,000 | 345,552 | 16,828,000 | 807,744 | 1,944,594 |
| Lyon | 10,000 | 980 | | | | | 395,403 |
| Mineral | 4,000 | 392 | 66,000 | 3,036 | | | 259,738 |
| Nye | 6,000 | 588 | 160,000 | 7,360 | | | 1,668,937 |
| Ormsby | | | | | | | 108 |
| Pershing | 14,000 | 1,372 | 96,000 | 4,416 | | | 176,461 |
| Storey | 4,000 | 392 | 4,000 | 184 | | | 1,752,717 |
| Washoe | 10,000 | 980 | 12,000 | 552 | | | 42,556 |
| White Pine | 77,020,000 | 7,547,960 | 190,000 | 8,740 | | | 9,943,516 |
| | 92,338,000 | 9,049,124 | 9,358,000 | 430,468 | 17,888,000 | 858,624 | 23,529,064 |
| Total, 1937 | 149,206,000 | 18,053,926 | 18,694,000 | 1,102,946 | 28,472,000 | 1,850,680 | 34,617,056 |

## MINING INDUSTRY

Curtailment of operations at the three large copper mines in Nevada was an outstanding feature of the mining industry in 1938. Production of copper ore decreased 29 percent compared with 1937. Production of ores valued chiefly for lead and zinc declined sharply but comprised a very small part of the total output of the State. There was a slight increase in quantity of dry and siliceous precious-metal material handled, and a smaller proportion of such material consisted of old tailings than in 1937. The installation of a large connected-bucket dredge, the first to operate in Nevada in several years, was a feature of the mining industry in 1938. The quantity of gravel handled at Nevada placers increased.

Getchell Mine, Inc., started production at the Getchell mine in the Potosi district of Humboldt County early in 1938 and was the third largest gold producer in the State during the year. The company was on a dividend-paying basis by the end of 1938. Among the major producers who ceased operations late in 1937 or during 1938 were: Eastern Exploration Co., Goldfield district, Esmeralda County; Arizona Comstock Corporation, Comstock district, Storey County; Buckhorn Mining Co., Buckhorn district, Eureka County; Treadwell Yukon Co., Ltd., Tybo district, Nye County; and Pioche Mines Consolidated, Pioche district, Lincoln County.

### ORE CLASSIFICATION

The following table classifying ores produced in Nevada in 1938 shows that 69 percent of the tonnage of ore (including old tailings) sold or treated was copper ore, 24 percent gold ore, 4 percent gold-silver ore, 2 percent silver ore, and the remaining 1 percent zinc-lead and lead ores.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

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*Ore and old tailings sold or treated in Nevada in 1938, with content in terms of recovered metals*

| Source | Ore and old tailings treated | | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | | | | | |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 886,994 | 512,734 | 197,434 | 584,636 | 227,100 | 88,200 | ---------- |
| Dry and siliceous gold-silver ore | 206,586 | 24,197 | 31,252 | 1,574,816 | 17,400 | 326,900 | ---------- |
| Dry and siliceous silver ore | 105,789 | 8,760 | 3,513 | 1,281,824 | 1,127,000 | 1,020,900 | 8,000 |
| | 1,199,369 | 545,691 | 232,199 | 3,441,276 | 1,371,500 | 1,436,000 | 8,000 |
| Copper ore | 4,043,892 | ---------- | 47,024 | 437,970 | 90,940,400 | 1,200 | ---------- |
| Lead ore | 28,325 | ---------- | 3,108 | 152,074 | 26,100 | 1,290,800 | ---------- |
| Zinc-lead ore | 62,744 | ---------- | 1,144 | 320,943 | ---------- | 6,630,000 | 17,880,000 |
| Total, lode mines | 5,334,330 | 545,691 | 283,475 | 4,352,263 | 92,338,000 | 9,358,000 | 17,888,000 |
| Total, placers | ---------- | ---------- | 12,959 | 3,208 | ---------- | ---------- | ---------- |
| | 5,334,330 | 545,691 | 296,434 | 4,355,471 | 92,338,000 | 9,358,000 | 17,888,000 |
| Total, 1937 | 6,958,702 | 606,764 | 281,332 | 4,864,750 | 149,206,000 | 18,694,000 | 28,472,000 |

## METALLURGIC INDUSTRY

Of the 5,880,021 tons of lode material sold or treated in 1938 in Nevada more than 70 percent was ore sent to concentration mills, 17.5 percent was ore sent to amalgamation and cyanidation mills, 9 percent was old tailings sent to amalgamation and cyanidation mills, 3 percent was ore shipped crude to smelters, and the remainder (less than 0.5 percent) was old tailings shipped to smelters. The principal changes from 1937 were a decrease in proportion of total ore sent to concentration mills and a marked increase in proportion of ore treated at amalgamation and cyanidation mills. In 1938 flotation was employed at concentration mills to the virtual exclusion of gravity concentration; in former years gravity concentration had been used on a larger part of the ore treated. At amalgamation and cyanidation mills much more of the material was treated by cyanidation than by amalgamation; nearly all the old tailings sent to such mills were cyanided. Of the total gold recovered as bullion, cyanidation accounted for 77 percent and amalgamation 23 percent. The quantity of crude ore shipped to smelters declined 37 percent from 1937. There was a very large drop in White Pine County, where decreased output of copper concentrates lessened the need for siliceous ores for fluxing purposes at the McGill smelter. Curtailed operations at the Mountain City copper property in the Cope district of Elko County and exhaustion of its very high grade smelting ore combined to decrease the output of copper ore from that property. The roaster and cyanide plant [2] at the Getchell mine was the outstanding addition to the metallurgical equipment of the State to start operating during 1938.

Custom mills were operated in various parts of the State during 1938; those of importance were at Silver City in Lyon County and at Searchlight, Goodsprings, and Nelson in Clark County. Most of the custom mills derived part of their mill feed from mines worked by the mill operators. Large quantities of ore and concentrates were

[2] Engineering and Mining Journal, vol. 139, No. 8, August 1938, p. 84.

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shipped out of the State, principally to lead and copper smelters in the Salt Lake Basin. The Bauer (Utah) plant of the Combined Metals Reduction Co. treated all the company zinc-lead ore mined at Pioche, Lincoln County. The McGill copper smelter at McGill, operated by the Nevada Consolidated Copper Corporation, continued in 1938 to be the only smelter and the most important metallurgical plant in the State.

*Mine production of metals in Nevada in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore and old tailings amalgamated | 458,485 | 35,151 | 28,901 | | | |
| Ore, old tailings, sands, slimes, and concentrates cyanided | 1,171,140 | 116,765 | 1,351,128 | [1] 1,300 | | |
| Concentrates smelted: | | | | | | |
| Flotation | 212,957 | 71,159 | 1,122,935 | 86,877,900 | 6,320,300 | 16,836,000 |
| Gravity | 343 | 3,123 | 5,820 | 2,600 | 26,400 | |
| Ore and old tailings smelted | 179,266 | 57,277 | 1,843,479 | 5,456,200 | 3,011,300 | 1,052,000 |
| Total, lode mines | | 283,475 | 4,352,263 | 92,338,000 | 9,358,000 | 17,888,000 |
| Total, placers | | 12,959 | 3,208 | | | |
| | | 296,434 | 4,355,471 | 92,338,000 | 9,358,000 | 17,888,000 |
| Total, 1937 | | 281,332 | 4,864,750 | 149,206,000 | 18,694,000 | 28,472,000 |

[1] From "cyanide" precipitates.

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1938, by types of mills and by counties, in terms of recovered metals*

AMALGAMATION MILLS

| County | Material treated | | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Churchill | 434 | | 31 | 142 | 5 | 3 | 58 | | |
| Clark | 35,671 | | 6,107 | 2,225 | 290 | 2,108 | 12,489 | 2,900 | 700 |
| Douglas | 120 | | 13 | 6 | | | | | |
| Elko | 1,689 | | 361 | 379 | 8 | 65 | 401 | | |
| Esmeralda | 71,611 | | 5,461 | 1,417 | 1,039 | 6,478 | 2,714 | 400 | 31,400 |
| Humboldt | 11,451 | 140 | 3,527 | 3,770 | | | | | |
| Lander | 921 | | 277 | 153 | 2 | 8 | 242 | | 300 |
| Lincoln | 1 | | 1 | 1 | | | | | |
| Lyon | 22,727 | 100 | 3,017 | 2,250 | 135 | 1,016 | 3,662 | 300 | |
| Mineral | 1,773 | | 663 | 388 | 33 | 110 | 385 | | |
| Nye | 21,602 | 1,750 | 6,648 | 3,042 | 469 | 1,612 | 1,001 | | |
| Pershing | 4,507 | 4 | 1,403 | 9,471 | 11 | 57 | 203 | | |
| Storey | 282,121 | 100 | 6,955 | 5,348 | 1,568 | 12,234 | 223,566 | 3,100 | 3,200 |
| Washoe | 1,460 | | 604 | 274 | | | | | |
| White Pine | 303 | | 83 | 35 | 9 | 27 | 5 | | |
| | 456,391 | 2,094 | 35,151 | 28,901 | 3,569 | 23,718 | 244,726 | 6,700 | 35,600 |
| Total, 1937 | 478,773 | 7,238 | 27,420 | 19,852 | 2,825 | 18,850 | 329,951 | 14,300 | 21,300 |

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*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1938, by types of mills and by counties, in terms of recovered metals*—Continued

CYANIDATION MILLS

| County | Material treated | | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ore[1] | Old tailings | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Churchill | 3,070 | 1,700 | 573 | 13,394 | | | | | |
| Clark | 34,320 | | 6,894 | 46,510 | | | | | |
| Douglas | 31 | | 13 | 6 | | | | | |
| Elko | 25,942 | 1,619 | 2,380 | 54,911 | | | | | |
| Esmeralda | 199,139 | [2] 370,468 | 41,184 | 807,921 | 9 | 3 | 1,913 | | 4,800 |
| Eureka | 20,000 | | 1,632 | 710 | 6 | 1,899 | 1,063 | | |
| Humboldt | 159,852 | | 23,586 | 2,028 | | | | | |
| Lander | 8,300 | 63 | 1,578 | 608 | | | | | |
| Lincoln | | 125,358 | 3,887 | 17,528 | | | | | |
| Lyon | 24,198 | 17,600 | 6,400 | 31,452 | | | | | |
| Mineral | 3,089 | 440 | 2,730 | 4,284 | 2 | 4 | 8 | | |
| Nye | 19,744 | 300 | 6,292 | 17,805 | | | | | |
| Pershing | 130 | 450 | 63 | 225 | | | | | |
| Storey | 140,348 | 12,579 | 19,552 | 345,920 | 96 | 160 | 4,191 | | |
| White Pine | | 2,400 | 1 | 7,826 | | | | | |
| | 638,163 | [2] 532,977 | 116,765 | 1,351,128 | 113 | 2,066 | 7,175 | | 4,800 |
| Total, 1937 | 433,677 | 571,915 | 79,883 | 774,249 | 142 | 644 | 67 | 3,500 | 1,200 |
| Grand total: | | | | | | | | | |
| 1938 | 1,094,554 | [2] 535,071 | 151,916 | 1,380,029 | 3,682 | 25,784 | 251,901 | 6,700 | 40,400 |
| 1937 | 912,450 | 579,153 | 107,303 | 794,101 | 2,967 | 19,494 | 330,018 | 17,800 | 22,500 |

[1] Ore figures include sands, slimes, and concentrates cyanided.
[2] Yielded also 1,300 pounds of copper from "cyanide" precipitates.

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*Gross metal content of concentrates from concentrating mills treating Nevada ore and old tailings in 1938, by classes of concentrates*

| Class of concentrates | Concentrates produced | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 4,767 | 915 | 12,355 | 1,101 | 143,400 | 337,873 |
| Dry gold-silver | 50 | 162 | 3,534 | | | |
| Dry silver | 27 | 9 | 10,068 | 286 | 598 | |
| Copper | 182,469 | 44,266 | 418,257 | 90,573,324 | | |
| Lead | 5,929 | 2,989 | 389,340 | 13,532 | 6,121,413 | 987,982 |
| Zinc | 16,376 | 157 | 43,300 | | 340,413 | 18,707,589 |
| | 209,618 | 48,498 | 876,854 | 90,588,243 | 6,605,824 | 20,033,444 |
| Total, 1937 | 311,778 | 81,249 | 1,471,728 | 139,175,851 | 15,094,984 | 30,977,222 |

*Mine production of metals from concentrating mills in Nevada in 1938, in terms of recovered metals*

BY COUNTIES

| | Material treated | | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Clark | 23,318 | | 146 | 2,157 | 50,836 | 5,200 | 20,400 | |
| Elko | 60,914 | | 20,338 | 229 | 8,612 | 9,861,700 | 10,000 | 8,000 |
| Humboldt | 939 | | 44 | 157 | 3,321 | | | |
| Lander | 2,588 | | 124 | 11 | 42,850 | 3,300 | 11,500 | |
| Lincoln | 76,072 | | 26,672 | 1,393 | 354,944 | 2,700 | 6,245,000 | 16,828,000 |
| Lyon | 50 | | 2 | 3 | 108 | | | |
| Storey | 1,000 | | 73 | 281 | 4,489 | 900 | 800 | |
| Washoe | 25 | | 12 | | 111 | | 2,900 | |
| White Pine | 3,969,474 | | 162,207 | 44,267 | 411,583 | 77,000,000 | 15,700 | |
| | 4,134,380 | | 209,618 | 48,498 | 876,854 | 86,873,800 | 6,306,300 | 16,836,000 |
| Total, 1937 | 5,905,908 | 210 | 311,778 | 81,249 | 1,471,728 | 132,906,135 | 14,380,000 | 27,797,300 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 4,767 | 915 | 12,355 | 900 | 107,629 | |
| Dry gold-silver | 50 | 162 | 3,534 | | | |
| Dry silver | 27 | 9 | 10,068 | 200 | 400 | |
| Copper | 182,469 | 44,266 | 418,257 | 86,861,500 | | |
| Lead | 5,929 | 2,989 | 389,340 | 11,200 | 5,874,893 | |
| Zinc | 16,376 | 157 | 43,300 | | 323,378 | 16,836,000 |
| | 209,618 | 48,498 | 876,854 | 86,873,800 | 6,306,300 | 16,836,000 |

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*Gross metal content of concentrates produced from ores mined in Nevada in 1938, by classes of concentrates*

| Class of concentrates | Concentrates produced | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 7,420 | 17,739 | 91,698 | 7,926 | 180,471 | 337,873 |
| Dry gold-silver | 1,068 | 9,111 | 173,937 | 3,182 | | |
| Dry silver | 36 | 12 | 11,981 | 286 | 5,648 | |
| Copper | 182,469 | 44,266 | 418,257 | 90,573,324 | | |
| Lead | 5,931 | 2,997 | 389,582 | 13,532 | 6,121,802 | 987,982 |
| Zinc | 16,376 | 157 | 43,300 | | 340,413 | 18,707,589 |
| Total, 1937 | 213,300 | 74,282 | 1,128,755 | 90,598,250 | 6,648,334 | 20,033,444 |
| | 317,596 | 101,704 | 1,833,264 | 139,200,884 | 15,119,597 | 30,977,222 |

*Mine production of metals from Nevada concentrates shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Churchill | 5 | 3 | 58 | | | |
| Clark | 436 | 4,265 | 63,325 | 8,100 | 21,100 | |
| Elko | 20,346 | 294 | 9,013 | 9,861,700 | 10,000 | 8,000 |
| Esmeralda | 1,048 | 6,481 | 4,627 | 400 | 36,200 | |
| Eureka | 6 | 1,899 | 1,063 | | | |
| Humboldt | 44 | 157 | 3,321 | | | |
| Lander | 126 | 19 | 43,092 | 3,300 | 11,800 | |
| Lincoln | 26,672 | 1,393 | 354,944 | 2,700 | 6,245,000 | 16,828,000 |
| Lyon | 137 | 1,019 | 3,770 | 300 | | |
| Mineral | 35 | 114 | 393 | | | |
| Nye | 469 | 1,612 | 1,001 | | | |
| Pershing | 11 | 57 | 203 | | | |
| Storey | 1,737 | 12,675 | 232,246 | 4,000 | 4,000 | |
| Washoe | 12 | | 111 | | 2,900 | |
| White Pine | 162,216 | 44,294 | 411,588 | 77,000,000 | 15,700 | |
| Total, 1937 | 213,300 | 74,282 | 1,128,755 | 86,880,500 | 6,346,700 | 16,836,000 |
| | 314,745 | 100,743 | 1,801,746 | 132,923,935 | 14,402,500 | 27,797,300 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 7,420 | 17,739 | 91,698 | 5,700 | 142,929 | |
| Dry gold-silver | 1,068 | 9,111 | 173,937 | 1,900 | | |
| Dry silver | 36 | 12 | 11,981 | 200 | 5,200 | |
| Copper | 182,469 | 44,266 | 418,257 | 86,861,500 | | |
| Lead | 5,931 | 2,997 | 389,582 | 11,200 | 5,875,193 | |
| Zinc | 16,376 | 157 | 43,300 | | 323,378 | 16,836,000 |
| | 213,300 | 74,282 | 1,128,755 | 86,880,500 | 6,346,700 | 16,836,000 |

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*Gross metal content of Nevada crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 59,368 | 35,213 | 120,350 | 243,324 | 66,544 | 861 |
| Dry and siliceous gold-silver | 55,183 | [1] 17,151 | [1] 1,119,203 | 16,342 | 246,577 | ---------- |
| Dry and siliceous silver | 32,442 | 525 | 407,070 | 1,225,996 | 1,054,306 | ---------- |
| Copper | 14,590 | 2,758 | 19,713 | 4,205,745 | 2,061 | ---------- |
| Lead | 4,852 | 950 | 101,089 | 26,040 | 1,352,448 | 4,682 |
| Zinc-lead | 2,211 | ---------- | ---------- | ---------- | 641,881 | 1,302,261 |
| | 168,646 | [1] 56,597 | [1] 1,767,425 | 5,717,447 | 3,363,817 | 1,307,804 |
| Total, 1937 | 266,215 | 63,523 | 2,266,372 | 16,833,374 | 4,830,800 | 934,263 |

[1] Includes gold and silver in 349 tons of gold-silver old tailings, metal content of which was not reported separately.

*Mine production of metals from Nevada crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Churchill | 2,210 | 910 | 63,141 | ---------- | 6,000 | ---------- |
| Clark | 4,372 | 2,785 | 15,004 | 19,900 | 550,900 | 1,052,000 |
| Douglas | 3 | 3 | 31 | ---------- | ---------- | ---------- |
| Elko | 13,056 | 2,903 | 34,569 | 3,444,200 | 292,000 | ---------- |
| Esmeralda | 6,596 | 7,938 | 34,782 | 2,300 | 27,800 | ---------- |
| Eureka | 24,718 | 5,051 | 137,695 | 4,000 | 258,000 | ---------- |
| Humboldt | 1,488 | 896 | 11,976 | 4,000 | 32,000 | ---------- |
| Lander | 12,528 | 5,542 | 84,405 | 796,700 | 72,200 | ---------- |
| Lincoln | 28,307 | 2,237 | 252,105 | 1,119,300 | 1,188,500 | ---------- |
| Lyon | 186 | 70 | 408 | 9,700 | ---------- | ---------- |
| Mineral | 3,595 | 2,583 | 59,450 | 4,000 | 66,000 | ---------- |
| Nye | 26,148 | 14,042 | 779,875 | 6,000 | 160,000 | ---------- |
| Pershing | 2,350 | 1,692 | 37,833 | 14,000 | 96,000 | ---------- |
| Washoe | 1,028 | 369 | 5,072 | 10,000 | 9,100 | ---------- |
| White Pine | 42,061 | [1] 9,576 | [1] 251,079 | 20,000 | 174,300 | ---------- |
| | 168,646 | [1] 56,597 | [1] 1,767,425 | 5,454,100 | 2,932,800 | 1,052,000 |
| Total, 1937 | 266,215 | 63,523 | 2,266,372 | 16,282,065 | 4,291,500 | 674,700 |

BY CLASSES OF ORE

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry and siliceous gold | 59,368 | 35,213 | 120,350 | 218,500 | 53,300 | ---------- |
| Dry and siliceous gold-silver | 55,183 | [1] 17,151 | [1] 1,119,203 | 14,300 | 213,500 | ---------- |
| Dry and siliceous silver | 32,442 | 525 | 407,070 | 1,121,500 | 963,300 | ---------- |
| Copper | 14,590 | 2,758 | 19,713 | 4,078,900 | 1,200 | ---------- |
| Lead | 4,852 | 950 | 101,089 | 20,900 | 1,252,000 | ---------- |
| Zinc-lead | 2,211 | ---------- | ---------- | ---------- | 449,500 | 1,052,000 |
| | 168,646 | [1] 56,597 | [1] 1,767,425 | 5,454,100 | 2,932,800 | 1,052,000 |

[1] Includes gold and silver from 349 tons of gold-silver old tailings, metal content of which was not reported separately.

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, by counties and districts, in terms of recovered metals* [1]

| County and district [1] | Mines producing [2] | | Ore and old tailings | Gold | | | Silver (lode and placer) [3] | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | | |
| **Churchill County:** | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Alpine | 1 | | 2 | 1 | | 1 | 24 | | 100 | | $55 |
| Broken Hills | 2 | | 78 | 16 | | 16 | 2,089 | | 3,600 | | 2,076 |
| Desert | 2 | | 345 | 30 | | 30 | 314 | | | | 1,253 |
| Dixie Valley | 2 | | 1,732 | 278 | | 278 | 324 | | | | 9,939 |
| Eastgate | 1 | | 66 | 73 | | 73 | 385 | | | | 2,804 |
| Fairview | 10 | | 3,344 | 303 | | 303 | 20,238 | | | | 23,688 |
| Holy Cross | 3 | | 14 | 14 | | 14 | 4,936 | | 2,300 | | 3,787 |
| Jessup | 1 | 1 | 28 | 21 | 1 | 22 | 36 | | | | 793 |
| Sand Springs | 3 | | 222 | 163 | | 163 | 6,192 | | | | 9,708 |
| Wonder | 9 | | 1,583 | 618 | | 618 | 42,198 | | | | 48,910 |
| **Clark County:** | | | | | | | | | | | |
| Crescent | 7 | | 253 | 29 | | 29 | 11,322 | 500 | 4,600 | | 8,595 |
| Eldorado Canyon | 5 | | 44,495 | 5,588 | | 5,588 | 107,261 | 5,300 | 20,600 | | 266,387 |
| Gold Butte | 2 | | 48 | 33 | | 33 | 16 | 100 | | | 1,175 |
| Searchlight | 28 | 1 | 4,646 | 4,053 | 13 | 4,066 | 6,871 | 3,000 | 9,400 | | 147,478 |
| Yellow Pine | 12 | | 26,450 | 10,348 | | 10,348 | 1,597 | 19,100 | 537,400 | 1,052,000 | 440,301 |
| **Douglas County:** | | | | | | | | | | | |
| Gardnerville | 1 | | 2 | 2 | | 2 | 24 | | | | 86 |
| Mt. Siegel | | 1 | | | 6 | 6 | 2 | | | | 211 |
| Mountain House | 2 | | 131 | 22 | | 22 | 11 | | | | 777 |
| Silver Glance | 3 | | 21 | 5 | | 5 | 8 | | | | 180 |
| **Elko County:** | | | | | | | | | | | |
| Castle Park | 1 | | 23 | | | | 31 | 4,000 | | | 412 |
| Centennial | 2 | | 809 | 282 | | 282 | 317 | 200 | 4,000 | | 10,279 |
| Contact | 3 | | 15 | 27 | | 27 | 88 | 2,800 | 200 | | 1,285 |
| Cope | 6 | 2 | 66,600 | 29 | 74 | 103 | 10,198 | 13,125,500 | 500 | | 1,296,521 |
| Cornucopia | 1 | | 2,250 | 316 | | 316 | 20,547 | 100 | | | 24,353 |
| Delano | 2 | | 162 | | | | 5,012 | 100 | 70,000 | | 6,470 |
| Dolly Varden | 1 | | 3 | | | | 27 | | 600 | | 45 |
| Gold Circle | 6 | | 25,856 | 2,442 | | 2,442 | 54,717 | | 800 | | 120,879 |
| Island Mountain | 3 | 1 | 181 | 62 | 3 | 65 | 236 | | 1,900 | | 2,515 |
| Jarbidge | 8 | | 1,391 | 400 | | 400 | 950 | | | | 14,614 |
| Lime Mountain | 1 | | 5,308 | 2,458 | | 2,458 | 7,368 | 162,000 | | | 106,669 |
| Mardis | 2 | | 67 | 194 | | 194 | 156 | 900 | | | 6,979 |
| Merrimac | 2 | | 259 | 2 | | 2 | 7,716 | 800 | 47,900 | 8,000 | 7,724 |
| Pilot Mountain | 1 | | 3 | | | | 127 | | | | 82 |
| Rock Creek | 1 | | 7 | | | | 336 | | | | 217 |
| Spruce Mountain | 6 | | 476 | 10 | | 10 | 8,140 | 5,200 | 157,100 | | 13,348 |
| Tecoma | 1 | | 23 | | | | 221 | | 19,000 | | 1,017 |
| Tuscarora | 7 | 2 | 1,395 | 32 | 3 | 35 | 3,264 | 4,400 | | | 3,766 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| **Esmeralda County:** | | | | | | | | | | | |
| Desert | 7 | 1 | 352 | 252 | 8 | 260 | 426 | | | | 9,375 |
| Divide | 6 | | 1,285 | 738 | | 738 | 23,815 | | | | 41,226 |
| Dyer | 1 | | 48 | 1 | | 1 | 4,731 | 400 | 5,100 | | 3,367 |
| Goldfield | 10 | | 348,519 | 9,292 | | 9,292 | 5,339 | 3,100 | 5,400 | | 329,224 |
| Hornsilver | 4 | | 6,258 | 1,689 | | 1,689 | 8,436 | 100 | 6,500 | | 64,877 |
| Klondyke | 3 | | 53 | 24 | | 24 | 1,356 | | 6,900 | | 2,034 |
| Lida | 1 | 5 | 1 | | 113 | 113 | 24 | | | | 3,971 |
| Lone Mountain | 1 | | 108,339 | 11,253 | | 11,253 | 24,211 | | | | 409,507 |
| Montezuma | 1 | | 14 | | | | 388 | | 2,400 | | 361 |
| Palmetto | 2 | 1 | 85 | 48 | 2 | 50 | 7 | | | | 1,755 |
| Silver Peak | 6 | | 182,860 | 37,767 | | 37,767 | 780,037 | 400 | 37,700 | | 1,827,884 |
| Sylvania | | 4 | | | 24 | 24 | 5 | | | | 843 |
| **Eureka County:** | | | | | | | | | | | |
| Buckhorn | 1 | | 2,792 | 551 | | 551 | 4,489 | | | | 22,187 |
| Cortez | 4 | | 20,430 | 3,563 | | 3,563 | 32,085 | 1,000 | 27,000 | | 146,786 |
| Diamond | 2 | | 529 | 5 | | 5 | 8,004 | | 8,200 | | 5,727 |
| Eureka | 17 | | 20,829 | 4,437 | | 4,437 | 84,732 | 1,000 | 208,500 | | 219,759 |
| Fish Creek | 1 | | 35 | | | | 238 | | 7,300 | | 490 |
| Lynn | 3 | 11 | 75 | 29 | 324 | 353 | 41 | | | | 12,382 |
| Mineral Hill | 3 | | 68 | | | | 903 | | | | 584 |
| Safford | 1 | | 46 | | | | 9,072 | 2,000 | 7,000 | | 6,383 |
| **Humboldt County:** | | | | | | | | | | | |
| Awakening | 8 | | 9,808 | 2,545 | | 2,545 | 1,603 | | | | 90,111 |
| Barrett Springs | 5 | | 425 | 362 | | 362 | 4,171 | 200 | 6,900 | | 15,703 |
| Central | 9 | | 159 | 52 | | 52 | 2,640 | 700 | 16,000 | | 4,331 |
| Donnelly | 2 | | 98 | 32 | | 32 | 33 | | | | 1,141 |
| Dutch Flat | | (4) | | | 6 | 6 | | | | | 210 |
| Florence | 4 | | 68 | 44 | | 44 | 306 | 700 | | | 1,806 |
| Gold Run | 5 | 4 | 835 | 261 | 56 | 317 | 4,071 | | 8,100 | | 14,099 |
| Jackson Creek | 1 | | 1 | 3 | | 3 | 1 | | | | 106 |
| National | 1 | 1 | 941 | 420 | 11 | 431 | 3,639 | | | | 17,437 |
| Potosi | 2 | | 159,857 | 23,574 | | 23,574 | 2,964 | | | | 827,006 |
| Rebel Creek | 1 | | 10 | 6 | | 6 | 8 | | | | 215 |
| Rosebud | | (4) | | | 246 | 246 | 29 | | | | 8,629 |
| Sawtooth | (5) | 1 | (5) | (5) | 13 | [6] 13 | [6] 1 | | | | [6] 456 |
| Varyville | 2 | 1 | 256 | 219 | 2 | 221 | 913 | 2,400 | | | 8,560 |
| Warm Springs | 2 | | 1,360 | 646 | | 646 | 59 | | | | 22,648 |
| **Lander County:** | | | | | | | | | | | |
| Battle Mountain | 24 | 7 | 10,666 | 4,396 | 1,833 | 6,229 | 27,083 | 770,300 | 18,700 | | 311,872 |
| Bullion | 9 | 10 | 9,501 | 2,103 | 4,200 | 6,303 | 25,787 | 8,700 | 46,600 | | 240,271 |
| Hilltop | 4 | | 435 | 360 | | 360 | 9,680 | 3,200 | 3,200 | | 19,319 |
| Kingston | 1 | | 288 | 42 | | 42 | 3,185 | | 300 | | 3,543 |
| Lewis | 3 | | 2,506 | 369 | | 369 | 48,211 | 17,500 | 14,300 | | 46,454 |
| McCoy | 1 | | 50 | 11 | | 11 | 4 | | | | 388 |
| New Pass | 2 | | 140 | 108 | | 108 | 46 | | | | 3,810 |
| Reese River | 5 | | 814 | 27 | | 27 | 14,992 | 300 | 900 | | 10,708 |

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 8 and output included under "Combined districts."

[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[3] Source of total silver as follows: 4,352,263 ounces from lode mines and 3,208 ounces from placers.

[4] Not reported. [5] Included under "Combined districts." [6] Exclusive of lode output, which is included under "Combined districts."

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*Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore and old tailings | Gold | | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | | |
| Lincoln County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Atlanta | 1 | | 34 | | | | 477 | 100 | 100 | | $323 |
| Caliente | 2 | | 82 | 68 | | 68 | 702 | | 1,100 | | 2,884 |
| Comet | 3 | | 1,067 | 109 | | 109 | 15,857 | 500 | 165,500 | | 21,728 |
| Eagle Valley | 3 | | 86 | 42 | | 42 | 206 | | | | 1,603 |
| Ferguson | 2 | | 126,297 | 5,369 | | 5,369 | 20,480 | 100 | | | 201,164 |
| Freiberg | 1 | | 90 | 2 | | 2 | 1,499 | | | | 1,039 |
| Groom | 1 | | 17 | | | | 80 | | 13,600 | | 677 |
| Jack Rabbit | 3 | | 24,899 | 222 | | 222 | 210,482 | 1,116,300 | 888,700 | | 294,117 |
| Pahranagat | 6 | | 96 | | | | 2,818 | 1,600 | 8,000 | | 2,347 |
| Pioche | 11 | | 77,987 | 1,849 | | 1,849 | 372,661 | 5,100 | 6,428,600 | 16,828,000 | 1,409,587 |
| Tempiute | 2 | | 491 | 2 | | 2 | 13,506 | 300 | 6,400 | | 9,125 |
| Lyon County: | | | | | | | | | | | |
| Cambridge | 2 | | 59 | 34 | | 34 | 2 | | | | 1,191 |
| Palmyra | 3 | | 283 | 99 | | 99 | 1,358 | | | | 4,343 |
| Pine Grove | 2 | | 206 | 74 | | 74 | 26 | 300 | | | 2,636 |
| Silver City | 36 | (5) | 62,199 | 10,280 | (5) | [7] 10,280 | [7] 36,464 | 300 | | | [7] 383,402 |
| Yerington | 6 | 2 | 111 | 19 | 23 | 42 | 32 | 9,400 | | | 2,412 |
| Mineral County: | | | | | | | | | | | |
| Aurora | 3 | | 68 | 16 | | 16 | 90 | | | | 618 |
| Bell | 3 | | 129 | 80 | | 80 | 369 | | 9,100 | | 3,457 |
| Candelaria | 1 | | 80 | 13 | | 13 | 816 | | 1,400 | | 1,047 |
| Eagleville | 1 | | 96 | 21 | | 21 | 311 | | | | 936 |
| East Walker | 6 | (5) | 277 | 251 | (5) | [7] 251 | [7] 353 | 300 | 1,700 | | [7] 9,121 |
| Fitting | 4 | | 59 | 166 | | 166 | 166 | | 700 | | 5,950 |
| Garfield | 2 | | 723 | 243 | | 243 | 26,722 | 1,300 | 27,200 | | 27,158 |
| Hawthorne | 11 | 1 | 2,012 | 1,899 | 3 | 1,902 | 6,796 | 1,200 | 10,200 | | 71,550 |
| Mountain View | 2 | | 45 | 24 | | 24 | 8 | | | | 845 |
| Pilot Mountain | 4 | | 531 | 60 | | 60 | 338 | | 300 | | 2,332 |
| Rand | 5 | | 949 | 254 | | 254 | 10,723 | | 1,900 | | 15,909 |
| Regent | 11 | 1 | 910 | 408 | 34 | 442 | 12,068 | | | | 23,272 |
| Santa Fe | 3 | | 52 | 25 | | 25 | 178 | | 300 | | 1,004 |
| Silver Star | 30 | | 2,863 | 2,630 | | 2,630 | 5,605 | 1,200 | 13,200 | | 96,398 |
| Nye County: | | | | | | | | | | | |
| Athens | 1 | | 1,516 | 638 | | 638 | 293 | | | | 22,519 |
| Bellehelen | 4 | | 87 | 52 | | 52 | 1,044 | | 1,100 | | 2,546 |
| Bullfrog | 17 | | 1,738 | 598 | | 598 | 594 | 600 | | | 21,373 |
| Cloverdale | | 2 | | | 24 | 24 | 14 | | | | 849 |
| Currrant | 1 | | 1 | 2 | | 2 | 2 | | | | 71 |
| Eden | 2 | | 303 | 3 | | 3 | 50 | | | | 137 |
| Fairplay | 2 | | 17 | 6 | | 6 | 243 | | | | 367 |
| Golden Arrow | 1 | | 36 | 8 | | 8 | 768 | | | | 776 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Hannapah | 1 | | 1 | | | | 79 | | | | 51 |
| Jackson | 7 | | 170 | 137 | | 137 | 417 | | 100 | | 5,069 |
| Johnnie | 3 | | 415 | 97 | 40 | 137 | 29 | | | | 4,814 |
| Lodi | | 1 | | | 1 | 1 | | | | | 35 |
| Mammoth | 4 | | 203 | 74 | | 74 | 731 | 2,900 | 7,600 | | 3,696 |
| Manhattan | 18 | 30 | 22,701 | 10,679 | 2,149 | 12,828 | 4,675 | | | | 452,002 |
| Millett | 4 | | 198 | 40 | | 40 | 6,352 | | 11,000 | | 6,012 |
| Morey | 1 | | 50 | 6 | | 6 | 2,459 | | | | 1,800 |
| Quartz Mountain | 2 | | 480 | 144 | | 144 | 7,731 | 2,500 | 100,100 | | 15,301 |
| Reveille | 1 | | 352 | 13 | | 13 | 5,196 | | | | 3,814 |
| Round Mountain | 6 | 2 | 1,962 | 742 | 1,698 | 2,440 | 2,478 | | | | 87,002 |
| San Antone | 2 | | 57 | 25 | | 25 | 1,686 | | 4,700 | | 2,181 |
| Silverton | 1 | | 51 | 1 | | 1 | 442 | | | | 321 |
| Tonopah | 14 | | 19,598 | 9,181 | | 9,181 | 715,266 | | 21,600 | | 784,723 |
| Troy | 1 | | 800 | 219 | | 219 | 44 | | | | 7,693 |
| Tybo | 1 | | 1,302 | 212 | | 212 | 30,988 | | | | 27,453 |
| Union | 4 | (5) | 153 | 19 | (5) | [7] 19 | [7] 4,355 | 4 | 4,800 | | [7] 3,701 |
| Ormsby County: Carson City | 1 | | | 3 | | 3 | | | | | 108 |
| Pershing County: | | | | | | | | | | | |
| Antelope | 14 | 5 | 878 | 264 | 153 | 417 | 6,387 | 6,200 | 67,300 | | 22,427 |
| Arabia | 1 | | 5 | | | | 99 | | 2,500 | | 179 |
| Buena Vista | 1 | | 920 | 26 | | 26 | 8,526 | | | | 6,422 |
| Central | 3 | | 351 | 20 | | 20 | 12,183 | 300 | 12,600 | | 9,185 |
| Echo | 1 | | 1 | 2 | | 2 | 1 | | | | 71 |
| Haystack | 1 | | 511 | 631 | | 631 | 144 | | | | 22,178 |
| Hualipi | 1 | | 45 | 115 | | 115 | 173 | 100 | 2,500 | | 4,262 |
| Imlay | 2 | 7 | 188 | 93 | 189 | 282 | 1,420 | | 1,100 | | 10,839 |
| Kennedy | 3 | | 192 | 205 | | 205 | 2,928 | 5,000 | 1,400 | | 9,622 |
| Pawsupp | 1 | | 8 | 2 | | 2 | | | | | 70 |
| Placerites | | 2 | | | 14 | 14 | [8] 3 | | | | 492 |
| Rochester | 13 | 3 | 975 | 370 | 7 | 377 | 8,658 | 600 | [4] 6,900 | | 19,168 |
| Rosebud | 3 | (4) | 504 | 457 | 413 | 870 | 3,974 | | | | 33,019 |
| Seven Troughs | 6 | | 1,513 | 655 | | 655 | 489 | | | | 23,241 |
| Sierra | 7 | 1 | 1,234 | 258 | 1 | 259 | 2,815 | 1,800 | 1,700 | | 11,139 |
| Trinity | 1 | | 2 | 1 | | 1 | 23 | | | | 50 |
| Willow Creek | 1 | | 23 | 84 | | 84 | 44 | | | | 2,968 |
| Storey County: Comstock | 36 | 2 | 397,415 | 39,182 | 99 | 39,281 | 583,645 | 4,000 | [4] 4,000 | | 1,752,717 |
| Washoe County: | | | | | | | | | | | |
| Galena | 4 | | 128 | 10 | | 10 | 946 | | 8,200 | | 1,339 |
| Granite Range | 1 | | 838 | 340 | | 340 | 1,844 | | | | 13,062 |
| Jumbo | | 1 | | | 2 | 2 | 32 | | | | 91 |
| Peavine | 1 | | 44 | 4 | | 4 | 1,033 | 1,200 | 3,800 | | 1,100 |
| Pyramid | 2 | | 175 | 15 | | 15 | 305 | 8,800 | | | 1,585 |
| Wedekind | 1 | | 32 | 2 | | 2 | 1,050 | | | | 749 |
| White Horse | 17 | 2 | 1,296 | 602 | 95 | 697 | 318 | | | | 24,600 |

[4] Not reported.
[5] Included under "Combined districts."
[7] Exclusive of placer output, which is included under "Combined districts."

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*Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore and old tailings | Gold | | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | | |
| White Pine County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Aurum | 6 | | 725 | 13 | | 13 | 14,616 | 17,900 | 27,700 | | $12,932 |
| Black Horse | 1 | | 2 | | | | 24 | | | | 16 |
| Cherry Creek | 17 | | 13,652 | 1,974 | | 1,974 | 123,878 | | 8,700 | | 149,573 |
| Eagle | 2 | | 119 | 9 | | 9 | 1,258 | 500 | 25,500 | | 2,350 |
| Granite | 4 | | 316 | 238 | | 238 | 125 | | 30,600 | | 9,818 |
| Newark | 1 | | 214 | 3 | | 3 | 3,253 | | | | 2,208 |
| Osceola | 8 | 7 | 3,328 | 2,113 | 987 | 3,100 | 1,819 | | 600 | | 109,704 |
| Robinson | 39 | | 3,997,090 | 49,673 | | 49,673 | 535,268 | 77,001,600 | 65,700 | | 9,633,766 |
| Taylor | 1 | | 243 | 4 | | 4 | 1,433 | | | | 1,066 |
| Ward | 2 | | 67 | 6 | | 6 | 488 | | | | 525 |
| White Pine | 5 | | 5,005 | 121 | | 121 | 24,576 | | 31,200 | | 21,558 |
| Combined districts [8] | 6 | 6 | 17,868 | 5,745 | 89 | 5,834 | 23,496 | | 1,000 | | 219,431 |
| Total Nevada | 795 | 130 | 5,880,021 | 283,475 | 12,959 | 296,434 | 4,355,471 | 92,338,000 | 9,358,000 | 17,888,000 | 23,529,064 |

[8] Includes following: Leonard Creek, Paradise Valley, and Sawtooth (lode) in Humboldt County; Silver City (placer) in Lyon County; East Walker (placer) in Mineral County; Phonolite and Union (placer) in Nye County; and Loring in Pershing County.

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### CHURCHILL COUNTY

*Dixie Valley district.*—The Comstock-Keystone Mining Co. treated 1,700 tons of impounded amalgamation tailings in 1938 by cyanide leaching at its Dixie mine between September 1 and the end of the year.

*Fairview district.*—The Nevada Hills mine was worked by Nevada Range Mines, Inc., and lessees in 1938; a substantial quantity of silver and gold was produced. The Reorganized Silver King Divide Mining Co. shipped gold-silver ore from the Road Runner mine to smelters.

*Sand Springs district.*—The treatment of 189 tons of ore from the Dan Tucker and Summit King mines in 1938 yielded 155 ounces of gold and 5,762 ounces of silver; all the ore was shipped, part to a smelter and the remainder to a custom cyanide plant. It is of interest to recall that during the early days of the Comstock Lode salt recovered from a dry lake in the Sand Springs district was transported by camels to the Lode for mills using the Washoe process.

*Wonder district.*—Lessees at the Nevada Wonder mine in 1938 shipped 1,419 tons of smelting ore, which contained 573 ounces of gold and 39,242 ounces of silver. Several other operations, all small, were reported in the Wonder district.

### CLARK COUNTY[3]

*Crescent district.*—During 1938 a lessee of the Paden mine shipped 189 tons of smelting ore which contained 2 ounces of gold, 7,244 ounces of silver, and 4,849 pounds of lead.

*Eldorado Canyon district.*—The El Dorado Rover Mining Co. worked the Flagstaff, Rover, and Skylark groups throughout 1938; the company 100-ton cyanide plant was completely rebuilt, and a large quantity of gold-silver ore was treated. The Diamond Gold Mining Co., which operated the Techatticup mine, enlarged its flotation mill by 30 tons to a daily capacity of 90 tons; the ore yielded a gold-lead concentrate which was shipped to a smelter. The ore mined by W. W. Hartman at the Wall Street mine was treated by amalgamation and flotation; the resulting concentrates were shipped to a smelter.

*Searchlight district.*—Lessees produced a substantial quantity of gold ore at the Blossom mine during the early months of 1938, but litigation suspended operations later in the year. The Duplex mine was worked by lessees throughout 1938; 84 tons of ore contained 151 ounces of gold, 169 ounces of silver, 6,087 pounds of lead, and 1,496 pounds of copper. Lessees shipped ore from the M & M mine to custom cyanide mills and smelters for treatment. In addition to shipping material from a clean-up of the mill, lessees of the Quartette mine shipped a substantial quantity of ore to smelters and custom mills. Other properties in the Searchlight district were operated on a small scale, mostly by lessees.

*Yellow Pine district.*—The Barefoot Lease, operator of the Barefoot and Golden Chariot mines in 1938, treated 1,020 tons of ore from the Barefoot mine by amalgamation and flotation and shipped 1,141 tons of ore and 25 tons of concentrates to smelters; 1,966

[3] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Clark County, Nev.: Bureau of Mines Inf. Circ. 6964, 1938, 81 pp.

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ounces of gold were recovered. A smelter shipment of 59 tons of ore from the Golden Chariot mine contained 154 ounces of gold, 30 ounces of silver, and 2,295 pounds of copper. The Chiquita Mining Co., Ltd., operated the Chiquita mine throughout the year; 21,789 tons of gold ore treated by amalgamation, cyanidation, and gravity concentration contained 8,179 ounces of gold, 526 ounces of silver, 3,298 pounds of copper, and 709 pounds of lead. Lessees of the Root Zinc mine on Bonanza Hill shipped 708 tons of zinc-lead ore, containing 473,334 pounds of zinc and 117,958 pounds of lead, and 21 tons of lead ore, containing 20,177 pounds of lead and 278 ounces of silver. The Yellow Pine Development Co. shipped a substantial quantity of zinc-lead ore.

### ELKO COUNTY

*Centennial district.*—Lead concentrates rich in gold were shipped from the Bull Run mine in 1938.

*Cope district.*—The Mountain City Copper Co. operated its Mountain City mine in 1938 from January 1 to May 31 and from November 1 to December 31. The company was the leading copper producer in Elko County and had the third-largest output of copper in the State. A substantial quantity of high-grade copper ore was shipped for smelting, but the bulk of the output was flotation concentrates from the 400-ton mill. An extensive exploration campaign was reported at the Rio Grande mine by the Rio Grande Copper Co,, subsidiary of the Sunshine Mining Co. of Idaho; no shipments were made.

*Cornucopia district.*—Old tailings containing gold and silver were shipped from the Cornucopia district in 1938.

*Delano district.*—Silver-lead ore was shipped to a smelter from the Net Nos. 1, 2, 3, and 4 by the Delno Mining & Milling Co. during 1938.

*Gold Circle district.*—Gold & Silver Circle Mines, Inc., treated by cyanidation in 1938 25,300 tons of gold-silver ore which yielded 2,303 ounces of gold and 53,631 ounces of silver; in addition, 64 tons of gold ore were shipped to a smelter.

*Island Mountain district.*—Bruneau Gold, Inc., treated 150 tons of ore by amalgamation and flotation during 1938 and recovered 50 ounces of gold and 15 ounces of silver; a 15- to 20-ton pilot stamp and flotation mill was completed on the property.

*Jarbidge district.*—J. W. Williams, lessee of the Alpha mine, treated in 1938, by amalgamation and cyanidation, 642 tons of ore containing 164 ounces of gold and 669 ounces of silver; operation covered the period May 1 to October 11. The same operator treated 410 tons of ore, mined at the Kookaboora claim, which yielded 97 ounces of gold and 140 ounces of silver.

*Lime Mountain district.*—In 1938 Lime Mountain Consolidated shipped to a smelter 5,308 tons of ore which contained 2,458 ounces of gold, 7,368 ounces of silver, and 182,701 pounds of copper; the operation was continuous throughout the year.

*Mardis district.*—Lessees of the Virginia mine in 1938 shipped 42 tons of ore which contained 172 ounces of gold, 145 ounces of silver, and 928 pounds of copper.

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*Spruce Mountain district.*—Leasing and development work at the property of the Missouri Monarch Consolidated Mines Co. during 1938 resulted in the shipment of 297 tons of lead ore which contained 2 ounces of gold, 6,984 ounces of silver, 128,048 pounds of lead, and 837 pounds of copper. Small shipments were made from several other properties in the Spruce Mountain district.

### ESMERALDA COUNTY

*Desert district.*—In 1938 a lessee of the Homestake No. 1 mine of the Gilbert Homestake Gold Mining Co. shipped 156 tons of gold ore which yielded 223 ounces of gold and 280 ounces of silver; 59 tons of the ore were treated at a custom cyanide plant, and 97 tons were smelted.

*Divide district.*—In 1938 the Tonopah Divide Mining Co. shipped to a smelter 1,133 tons of ore which contained 672 ounces of gold and 23,331 ounces of silver.

*Dyer district.*—In 1938 Molini Bros. operated the Silver King mine, a new strike 14 miles northwest of Dyer post office on the State line; 48 tons of lead ore shipped for smelting contained 1 ounce of gold, 4,731 ounces of silver, 466 pounds of copper, and 5,309 pounds of lead; most of the ore was mined at the surface.

*Goldfield district.*—Lessees shipped a small quantity of high-grade gold ore for smelting from the Combination Fraction during 1938. The Eastern Exploration Co. and other lessees shipped 1,551 tons of ore, containing 2,596 ounces of gold, for smelting from the Florence and Merger claims of the Goldfield Deep Mines Co. of Nevada. Lessees worked the property of the Goldfield Consolidated Mines Co. throughout the year; 5,985 feet of development work were done. The Eastern Exploration Co., largest gold producer in the Goldfield district in 1936 and 1937, suspended operations at Goldfield during 1938. The Bradshaw Syndicate, Inc., most productive lessee on the Goldfield Consolidated property, treated 344,000 tons of old tailings by cyanidation to recover 3,545 ounces of gold and 2,713 ounces of silver between April 6 and December 18; the 1938 season marked the beginning of a program for the re-treatment of 1,600,000 tons of tailings discharged during earlier operations of the company.

*Hornsilver district.*—In 1938 a lessee of the Empress and Gold Bug mines, 40 miles south of Goldfield, shipped to smelter 172 tons of ore which contained 210 ounces of gold, 276 ounces of silver, 183 pounds of copper, and 6,367 pounds of lead. The Ohio Mines Corporation worked the Goldpoint and Tokop (Orleans group) mines throughout the year; the ore was treated by cyanidation in the 50-ton cyanide mill of the company.

*Lone Mountain district.*—The Weepah Nevada Mining Co. exhausted its known ore reserves at the Weepah mine and began during 1938 to re-treat flotation tailings; 81,871 tons of ore and 26,468 tons of old tailings were cyanided to recover 11,253 ounces of gold and 24,211 ounces of silver.

*Silver Peak district.*—A small quantity of high-grade gold ore was shipped to a smelter from the Brodie mine in 1938. Gold ore for smelting was shipped from the Coyote mine also. The Black Mammoth Consolidated Mining Co., operator of the Mary mine, was the

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largest producer (in terms of gold output, tonnage of ore, and total value of production) in the Silver Peak district; in 1938 the company purchased the Mary mine, which it had formerly operated under lease from the Pittsburg Silver Peak Gold Mining Co. The company operated its 100-ton cyanide mill. A part of the company property was worked independently by the Prescott Lease, which built a 300-ton amalgamation and flotation mill. Desert Silver, Inc., treated 69,678 tons of ore from the Nivloc mine in 1938 at its 175-ton all-slime cyanide mill to recover 2,709 ounces of gold and 768,280 ounces of silver, drove 5,521 feet of development headings, and built a precious-metal refinery; the company was the largest silver producer in the State. The Gold Wedge Divide Mining Co. treated part of its ore by cyanidation and shipped part to a smelter.

### EUREKA COUNTY [4]

*Buckhorn district.*—In 1938 lessees shipped to a smelter from the Ace No. 3 claim 2,792 tons of Buckhorn dump ore which contained 551 ounces of gold and 4,489 ounces of silver.

*Cortez district.*—The Cortez Metals Co. shipped silver ore from its property in 1938 for smelting. The most productive operation in the Cortez district was in the Mill Canyon section, where the property formerly worked by the Roberts Mining & Milling Co. was taken over by Greenan & Co., Inc.

*Diamond district.*—Smelter shipments from the Diamond district in 1938 included silver ore from the Wynona mine and silver-lead ore mined by the Summit Peak Mining Co.

*Eureka district.*—In 1938 the Eureka Prospect Co. shipped to smelters from the Diamond-Excelsior mines 1,374 tons of gold-silver ore containing 355 ounces of gold, 13,010 ounces of silver, 1,348 pounds of copper, and 88,826 pounds of lead; the mine was closed down except for leasing. Cardinalli & Frank (lessees) and sublessees on the property of Eureka Mines, Inc., shipped 310 tons of lead ore for smelting; the ore contained 97 ounces of gold, 6,056 ounces of silver, and 58,528 pounds of lead. The Eureka Corporation, Ltd., worked several properties in the Eureka district and shipped the output to smelters; gold-silver ore was shipped from the Helen, Jackson, and Phoenix mines and gold ore and lead ore from the Richmond-Eureka mine. Gold ore was shipped from the Silver Conner mine and gold-silver old tailings from the Windfall tailings pile. Several smaller producers in the district reported smelter shipments.

*Lynn district.*—A number of placer and lode properties were active in the Lynn district in 1938; however, the output of the most productive, a placer property, was only 55 ounces of gold.

*Safford district.*—A small smelter shipment of silver-lead ore mined during 1938 was made from the Morning Glory property.

### HUMBOLDT COUNTY [5]

*Awakening district.*—The Alabama mine was worked by the Alabama Syndicate, lessee, from March 15 to August 31, 1938. A large quantity of gold ore from the Jumbo mine was treated by amalgamation; the mine was operated between April 1 and December 31.

[4] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Eureka County, Nev.; Bureau of Mines Inf. Circ. 7022, 1938, 66 pp.

[5] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Humboldt County, Nev.; Bureau of Mines Inf. Circ. 6995, 1938, 54 pp.

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*Barrett Springs district.*—Gold ore from the King Gold No. 3 was treated by amalgamation in 1938. A development campaign at the Pansy Lee mine by West Coast Mines, Inc., resulted in the production of 189 tons of smelting ore which contained 59 ounces of gold, 4,023 ounces of silver, 208 pounds of copper, and 9,240 pounds of lead; 1,850 feet of development work were done in 1938.

*Central district.*—A number of small shipments of ore and bullion were made from the Central district during 1938.

*Gold Run district.*—Marigold Mines, Inc., was the leading producer among a number of lode and placer operators in the Gold Run district in 1938.

*National district.*—The P. H. O'Neil Corporation worked the National mine in 1938; 161 pounds of high-grade gold ore yielded 199 ounces of gold and 212 ounces of silver by barrel amalgamation, 1 ton of smelting ore contained 64 ounces of gold and 105 ounces of silver, and 939 tons of ore treated by flotation yielded 44 tons of concentrate which contained 157 ounces of gold and 3,321 ounces of silver.

*Potosi district.*—Getchell Mine, Inc., started production at the Getchell mine March 1, 1938, and by the end of the year had established itself as the leading mining enterprise in Humboldt County; the ore was mined in an open pit and delivered to the 600-ton cyanide plant by truck. Oxide ore was treated by slime agitation and sand leaching and sulfide ore by roasting followed by all-slime cyanidation. During the year 4,072 feet of development work were done. On September 21, 1938, the company declared its first dividend.

*Varyville district.*—Columbia Mines, Inc., shipped gold ore in 1938 for smelting from the Gurney Gordon mine.

*Warm Springs district.*—Ore mined at the Ashdown property, near the Nevada-Oregon State line, was treated in 1938 by amalgamation; the mine was operated during the last 3 months of the year.

### LANDER COUNTY [6]

*Battle Mountain district.*—In 1938, as in 1937, lessees at the numerous small mines in the Battle Mountain district produced most of the ore shipped for smelting. The Copper Canyon Mining Co., which operated mines of the Copper Canyon Group and the Copper Basin Group, was the leading producer of the district; part of its property was worked on company account and part through lessees; and, in all, 7,564 tons of copper ore, which contained 2,673 ounces of gold, 13,959 ounces of silver, and 776,881 pounds of copper, were shipped for smelting. The company's development program was discontinued in April, awaiting completion of financing, but curtailed operations, principally stoping, were continued through 1938. Treatment of 500 tons of surface material at the Homestead and Lindy Group yielded 111 ounces of gold and 46 ounces of silver. The Buffalo Valley Mines Co. shipped gold ore for smelting from the Honeycomb Group 17 miles south of Valmy. Lessees on the San Miguel mine shipped 1,429 tons of gold ore which contained 1,075 ounces of gold, 2,684 ounces of silver, 2,665 pounds of copper, and 6,109 pounds of lead. Other active lode mines in the district included the Armour, Bailey Day, Bentley, Big Florence, Big Four Annex, Billie Dog, Black Butte Group, Blue Bird,

[6] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Lander County, Nev.: Bureau of Mines, Inf. Circ. 7043, 1939, 83 pp.



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Buzzard, Gold Butte Group, Gold Cash, Independence, Lucky Strike, Minnie, Morning Star, Snow Storm, and Tomboy. F. C. Madsen recovered 113 ounces of gold by dry washing at the Box Canyon Placers property. Chase & Caldwell took over control and operation of the Dahl Placers mine from the Grand Hills Mining Co. on August 15, 1938; during the year 1,043 ounces of gold and 136 ounces of silver were produced at the property from 6,403 cubic yards of virgin gravel, extracted by drift mining, and 7,000 cubic yards of tailings. Other productive placer properties in the district included the Copper Canyon, Eva B, Guy Davis, Poorman, and Vail.

*Bullion district.*—E. J. Bumsted operated the Goldacres mine throughout 1938; 8,300 tons of ore were crushed to 2-inch mesh and given a 7-day leach in a 2-pound cyanide solution, and 1,572 ounces of gold and 320 ounces of silver were recovered. Production was recorded from the Gold Quartz mine during the year. The Gray Eagle Mining Co. shipped to smelter from the Gray Eagle mine 913 tons of gold-silver ore which contained 254 ounces of gold, 22,431 ounces of silver, 8,056 pounds of copper, and 47,479 pounds of lead. The Mill Gulch Placer Mining Co. operated a washing plant and dragline and was the largest producer of placer gold in the State. A number of lessees using small-scale hand methods on the Independence and the Triplett Group mines produced substantial quantities of placer gold.

*Hilltop district.*—Crude ore was shipped during 1938 for smelting from the Blue Dick, Hilltop, Paymaster, and Pittsburg Red Top mines.

*Kingston district.*—A lessee worked the Kingston mine throughout 1938 and produced 188 tons of gold ore and 100 tons of silver ore containing 42 ounces of gold, 3,185 ounces of silver, and 389 pounds of lead; the gold ore was treated by amalgamation and concentration, and the silver ore and 2 tons of lead concentrate were shipped to a smelter.

*Lewis district.*—Gold & Silver Circle Mines, Inc., worked the Betty O'Neal mine in 1938; part of the mine output was treated by flotation followed by smelting of concentrates and part was shipped for direct smelting. A lessee on the Dean mine shipped to a smelter 57 tons of ore which contained 145 ounces of gold and 756 ounces of silver. The Calgrason Mining Co., operator of the Treasure Vault mine, shipped to smelter 391 tons of ore which contained 197 ounces of gold, 3,664 ounces of silver, and 13,598 pounds of copper.

*Reese River district.*—The Austin Silver Mining Co. worked its group of mines (including the Jack Pot, Camargo, Littrell, Eclipse, and North Star) from January 1 to May 1, 1938; material shipped to a smelter included crude silver ore and silver concentrate from ore treated in the company 120-ton flotation mill. During 1938 four stockholders of the company were awarded a judgment against those financing it; this was the first such award rendered under the financiers' liability clause (sec. 11) of the Securities and Exchange Commission Act of 1933.

### LINCOLN COUNTY

*Comet district.*—Lessees shipped lead ore and dry silver old tailings from the Prince mine in 1938.

*Ferguson district.*—Cyanidation of Delamar tailings by the Caliente Cyanidation Co. was the outstanding activity in the Ferguson district

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during 1938. Smelter shipments of gold ore by lessees on the Delamar Exploration Co. property were recorded also.

*Jack Rabbit district.*—The Bristol Silver Mines Co., largest producer in the Jack Rabbit district in 1938, shipped a substantial quantity of mine and dump ore to a smelter; the material yielded silver, copper, lead, and gold.

*Pioche district.*—The Combined Metals Reduction Co., operator of the Pioche No. 1 mine, was the leading producer of both zinc and lead in Nevada during 1938; the company was also one of the leading silver producers of the State. A small quantity of lead ore was shipped by the company for direct smelting, but most of the output—argentiferous zinc-lead ore—was shipped to the company 600-ton flotation mill at Bauer, Utah, where gold (iron) concentrate, lead concentrate, and zinc concentrate were made. Pioche Mines Consolidated treated a substantial quantity of dump ore from the Raymond and Ely mines by flotation during the first 3 months of the year.

*Tempiute district.*—Lessees on the Sterling mine of the Tempiute Mining Co. shipped silver ore to a smelter in 1938.

### LYON COUNTY

*Silver City district.*[7]—Lessees shipped ore to custom mills from the Buckeye mine during 1938; some was amalgamated, some was cyanided, and some received both treatments. The Dayton Consolidated Mines Co., operator of the Dayton mine, continued to be the leading producer of both gold and silver in the Silver City district; it operated also the Oest and Kossuth mines in this district, as well as properties in the Comstock district of Storey County. In addition to company ore, a large quantity of custom ore was treated in its cyanide mill. The Dayton Douglas Cyanidation Co. cyanided old tailings in its 100-ton leaching plant at the Douglas tailings dump from April 1 to November 15. Lessees on the Haywood and Montezuma mines shipped ore to custom mills. Ore shipped by lessees on the Silver King mine was cyanided and amalgamated at custom mills. A large quantity of ore from the property of South Comstock Gold Mines, Inc., was treated by amalgamation and flotation; the resulting concentrates were shipped to a smelter. Lessees on the Vivian mine shipped ore to a custom cyanide mill. A lessee on the Wonder Extension mine shipped ore to custom mills.

### MINERAL COUNTY

*East Walker district.*—Several small outputs of gold ore from the East Walker district were recorded in 1938. The Eureka mine was the largest gold producer.

*Fitting district.*—High-grade gold ore was produced at the Western Duke claims during 1938; part of the material was treated by amalgamation and part shipped to a smelter.

*Garfield district.*—The New Eldorado Mines Co. shipped gold-silver ore in 1938 for smelting from the Garfield mine. Lessees shipped gold-silver ore for smelting from the Mabel mine.

[7] *See also* Gianella, Vincent P., Geology of the Silver City District and the Southern Portion of the Comstock Lode, Nev.: Univ. Nevada Bull., vol. 30, No. 9, 1936, 108 pp.

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*Hawthorne district.*—The Nevada Miners Trust Estate leased the Silent Partner Group to the Borealis Mines Trust Estate June 16, 1938; the lessee shipped 792 tons of gold ore to a custom cyanide mill, where 610 ounces of gold and 1,008 ounces of silver were recovered; construction of a 25-ton cyanide leaching plant was begun at a site 1 mile southwest of Fletcher. Gold ore was shipped to a custom cyanide mill and a smelter from the Ashby Gold Mines Co. property in 1938.

*Rand district.*—The Nevada Rand Mining Co. held a lease and option on the Nevada Rand mine for part of 1938, during which time gold-silver ore was shipped to a smelter and a custom cyanide plant.

*Regent district.*—Gold ore from the Heckla mine was shipped to a smelter and a custom cyanide plant in 1938. Smelter shipments were also made from the Wild West mine.

*Silver Star district.*—A lessee on the Fortuna, Keystone, and Hardscrabble mines in 1938 shipped to custom plants 110 tons of ore which yielded 100 ounces of gold and 74 ounces of silver. Shipments from the Mary Ann mine yielded substantial quantities of gold. Bullion and gold ore were shipped from the Sunset mine.

### NYE COUNTY

*Athens district.*—The Warrior was the only mine in the Athens district from which production in 1938 was reported.

*Bullfrog district.*—The U. S. Milling Corporation worked the Polaris mine during 1938; a 100-ton flotation mill was reported to have been built by the company.

*Manhattan district.*—Lessees on the Jumping Jack Merger property treated 1,200 tons of old tailings by amalgamation in 1938 and recovered 106 ounces of gold and 47 ounces of silver. Ore mined by lessees at the property of the Manhattan Consolidated Mines Development Co. was treated by flotation, and the concentrates were shipped for smelting. Lessees worked the property of the Nevada Coalition Gold Mines Co. Production was recorded from the Sunday No. 2 mine of the Manhattan Gold Mines Co. The Reliance Mining Co., operator of the Verden mine, was the largest producer in the Manhattan district in 1938. Lessees shipped 3,277 tons of gold ore from the White Caps mine; the ore yielded 3,171 ounces of gold and 173 ounces of silver. Gold was reported produced at the Ajax mine, which was worked by small-scale hand methods. The Manhattan Gold Dredging Co. installed an electric dredge, having one hundred and eight 9½-cubic foot buckets, on the Gold Bench and Gold Bench No. 1 claims 4 miles west of Manhattan; dredging started November 15, and 459,792 cubic yards of gravel had been handled by the end of the year. This was the first dredge of the connected-bucket type to operate in Nevada in a number of years. Lessees on the Jack drift placer produced a substantial quantity of gold. Sluicing operations at the Little Grey mine produced a sizable output of gold between April 1 and the end of the year. Between January 3 and May 30, 123 ounces of gold were produced at the Manhattan No. 1 placer property from 840 cubic yards of gravel. Several lessees treated 1,633 cubic yards of gravel from the Orphant drift placer and recovered 190 ounces of gold.

*Millett district.*—Shipments (152 tons) of silver ore from the Grant mine in 1938 contained 23 ounces of gold, 6,064 ounces of silver, and 11,505 pounds of lead; a tramway and ore bins were constructed.

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*Phonolite district.*—Lessees shipped 228 tons of ore from the Derelick mine to a custom cyanide mill and a smelter during 1938; 126 ounces of gold and 6,074 ounces of silver were recovered. The Penelas Mining Co., second largest producer in Nye County, operated its mine and 50-ton cyanide mill throughout the year.

*Quartz Mountain district.*—A lessee worked the San Rafael mine during 1938.

*Round Mountain district.*—Gold Hill Mines, Inc., worked the Gold Hill mine from June 1 to December 1, 1938; 1,015 tons of ore were treated in the company 100-ton cyanide plant and 74 tons were shipped to a smelter; the total metal yield was 410 ounces of gold and 1,002 ounces of silver. The leading producer in the Round Mountain district in 1938 was the Nevada Porphyry Gold Mines Co., which operated the placer section of its property by hydraulicking from March 22 to August 10 on company account and for the rest of the year through a lessee.

*Tonopah district.*—In 1938, from the first of the year until August 1, the Tonopah Belmont Development Co. leased the Tonopah Belmont mine to the Belmont Lease which operated it through sublessees; during the last 5 months of the year the owner leased directly to the miners. In all, 7,028 tons of gold-silver ore shipped to smelters contained 2,574 ounces of gold, 231,830 ounces of silver, and 22,329 pounds of lead. Miscellaneous lessees at the Tonopah Extension mine shipped 250 tons of smelting gold-silver ore which contained 51 ounces of gold and 5,700 ounces of silver. Several sets of lessees produced the entire output of the property of the Tonopah Mining Co. of Nevada in 1938. Ore from the West End mine was shipped by lessees.

*Tybo district.*—In 1938, from November 1 to the end of the year, lessees shipped to a smelter 1,302 tons of ore containing 212 ounces of gold and 30,988 ounces of silver; the ore was derived largely from old dumps at the Tybo property of the Treadwell Yukon Co., Ltd.

### PERSHING COUNTY

*Central district.*—Lessees shipped 348 tons of silver ore from the Keystone mine to a smelter in 1938; the ore contained 10 ounces of gold, 12,166 ounces of silver, 306 pounds of copper, and 18,089 pounds of lead.

*Haystack district.*—The Jungo Star Gold Mines Co. shipped 511 tons of ore to a smelter during 1938; the ore contained 631 ounces of gold and 144 ounces of silver.

*Hualipi district.*—In 1938 lessees on the Bucks Head mine, 19 miles north of Gerlach, shipped to a smelter 45 tons of ore which contained 115 ounces of gold, 173 ounces of silver, 135 pounds of copper, and 2,656 pounds of lead.

*Imlay district.*—The largest output in the Imlay district in 1938 came from the Willow Creek drift placer worked by lessees.

*Kennedy district.*—Gold ore was shipped in 1938 for smelting from the Gold Note mine. Small shipments of ore were reported from the Black Hawk and Sunnyside mines also.

*Rochester district.*—Gold ore mined at the Looney property during 1938 was treated by amalgamation and concentration. The Wabash Quartz Mining Claim Corporation, Ltd., shipped from the Wabash mine 170 tons of smelting ore containing 1 ounce of gold, 6,774 ounces of silver, 651 pounds of copper, and 9,514 pounds of lead.

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*Rosebud district.*—The Gold Box Mining Co. shipped gold ore from its mine in the Box Canyon section of the Rosebud district during 1938. More than 400 ounces of placer gold recovered by small-scale methods, mostly dry washing, were reported for the Rosebud district.

*Seven Troughs district.*—Most of the output of the Seven Troughs district in 1938 was credited to various lessees on properties of the Nevada State Gold Mines Co.

### STOREY COUNTY

*Comstock district.*—Several small-scale operators worked parts of the California and Virginia claims of the Consolidated Virginia Mining Co. during 1938; the most productive operation was on dump material removed from the mine in about 1912 and recovered from the Sutro tunnel dump. Sutro Tunnel Coalition, Inc., continued cyaniding gold-silver ore mined at the Crown Point property. During the early months of the year the Arizona Comstock Corporation worked the section of the Comstock Lode covered by the Gould and Curry, Savage, Hale and Norcross, and Chollar-Potosi claims. Later the company went into receivership, and after a period of litigation the Consolidated Sierra Mining & Milling Corporation took over the property; the former company treated a substantial quantity of gold-silver ore, but the latter organization had not begun production at the mines by the end of 1938. The Dayton Consolidated Mines Co. worked the Justice and Keystone mines and hauled the ore by truck to its cyanide plant at the Dayton mine, a mile or two south, in the Silver City district of Lyon County. Storey County Mines, Inc., worked the Overland mine during 1938; a 100-ton cyanide leaching plant was added to the company 40-ton flotation mill. The Consolidated Chollar Gould & Savage Mining Co. worked the Overman mine throughout the year, treated 121,539 tons of ore by amalgamation and flotation, and produced 1,006 tons of concentrate; the bullion contained 395 ounces of gold and 275 ounces of silver, and the concentrates contained 8,892 ounces of gold, 169,815 ounces of silver, and 3,182 pounds of copper. The Silver Hill Mining Co. worked the Silver Hill property (Lucerne-Echo claims) both on company account and through lessees throughout the year; the company mill, which did a substantial custom business, was enlarged to 100 tons daily capacity. Production was recorded from the Succor mine. Sierra Nevada, Ltd., which operated the Sierra Nevada mine, was one of the larger producers in the Comstock district during 1938; a large slide of waste into the company open-cut seriously affected output late in the year.

### WASHOE COUNTY

*Granite Range district.*—In 1938 W. H. Swank and L. E. Donner, owners of the Mountain View mine, shipped to smelter 838 tons of ore which contained 340 ounces of gold and 1,844 ounces of silver.

*White Horse district.*—The work of several lessees on the Texas No. 2 property made it the most productive in the White Horse district in 1938.

### WHITE PINE COUNTY

*Cherry Creek district.*—Silver ore was shipped from the Black Metal mine to the McGill smelter of the Nevada Consolidated Copper Corporation in 1938. Lessees on the Egan mine shipped gold-silver ore

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and old tailings to this smelter. The Nevada Standard Mining Corporation, leading operator in the Cherry Creek district in 1938, shipped gold-silver ore. Lessees were active at the Wide West mine.

*Granite district.*—Lessees at the Stinson mine in 1938 shipped to smelter 182 tons of ore which contained 236 ounces of gold and 68 ounces of silver.

*Osceola district.*—The Nevada Tex Mining Co. shipped smelting ore from the Gilded Age and Woodman mines during 1938. The Placers Recovery Co., operator of the Hampton hydraulic placer mine, was the leading producer of placer gold in the Osceola district.

*Robinson district.*—The Consolidated Coppermines Corporation operated throughout 1938. The copper ore, all produced on company account, was shipped to the concentrator of the Nevada Consolidated Copper Corporation at McGill for treatment; various lessees were responsible for the dry ore produced at the company's extensive holdings in the Robinson district. According to the printed annual report of the company for the year ended December 31, 1938, 1,953,215 tons of ore mined on company account yielded 40,140,763 pounds of copper, 20,901 ounces of gold, and 44,163 ounces of silver; 11,562 tons of lessee ore yielded 1,593 ounces of gold, 47,998 ounces of silver, and 2,445 pounds of lead. D. F. Paine worked the Hayes mine, and L. Piombo worked the Jupiter mine. The Ely Gold Mining Co. shipped a substantial quantity of gold ore for smelting from the Revenue mine. The Nevada Consolidated Copper Corporation, operating subsidiary of the Kennecott Copper Corporation and the largest industrial company in Nevada, worked the Ruth mine at Ruth and its open pit at Copper Flat throughout 1938 except for a shut-down from June 15 to August 1; it handled more ore and produced more copper than any other operation in the State. In addition to its mining activities the company operated the McGill copper smelter (only smelter in the State) and the McGill flotation concentrator (18,000 tons daily capacity); both of these plants did custom work. Gold-silver ore was shipped to the McGill smelter from the Sophie mine. C. Caviglia shipped old tailings from the Steptoe Creek tailings dump for smelting.

*White Pine district.*—Small quantities of ore and old tailings, containing chiefly silver, were produced at mines in the White Pine district during 1938.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

## SUMMARY OUTLINE


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The mine production of recoverable gold in New Mexico in 1938 increased in both quantity and total value over 1937, as the price remained the same in both years. The production of recoverable zinc also gained in quantity, but the total value was less than in 1937 because of the reduced average price. The output of recoverable silver, copper, and lead decreased in both quantity and value. The decrease in quantity is attributable almost entirely to curtailment of production by three important producers in the Central district, Grant County; and part of the large decrease in total value of each of these three metals resulted from the decline in average price. There was an increased output of zinc in the Central district; of gold and silver in the Mogollon district, Catron County, and Steeple Rock district, Grant County; and of copper, gold, and silver in the Lordsburg district, Hidalgo County. Production of gold, silver, copper, lead, and zinc from the Pecos mine in the Willow Creek district, San Miguel County, was slightly higher than in 1937.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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The following table shows the number of mines in New Mexico producing gold, silver, copper, lead, and zinc; the annual output from 1934 to 1938; and the total production from 1848 to 1938.

*Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1934–38, and total, 1848–1938, in terms of recovered metals*

| Year | Mines producing | | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 153 | 328 | 1,397,709 | 27,307.01 | $954,380 | 1,061,775 | $686,400 |
| 1935 | 150 | 234 | 440,799 | 33,435.00 | 1,170,225 | 1,061,902 | 763,242 |
| 1936 | 136 | 169 | 514,966 | 33,037.00 | 1,156,295 | 1,163,255 | 900,941 |
| 1937 | 159 | 160 | 4,191,092 | 41,171.00 | 1,440,985 | 1,243,766 | 962,053 |
| 1938 | 166 | 164 | 2,414,857 | 43,050.00 | 1,506,750 | 1,229,860 | 795,061 |
| 1848–1938 | | | (1) | 2,048,013.00 | 45,014,648 | 61,139,542 | 48,253,596 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 23,630,000 | $1,890,400 | 18,729,000 | $692,973 | 53,043,000 | $2,280,849 | $6,505,002 |
| 1935 | 4,505,000 | 373,915 | 14,578,000 | 583,120 | 44,252,000 | 1,947,088 | 4,837,590 |
| 1936 | 6,332,000 | 582,544 | 13,252,000 | 609,592 | 41,336,000 | 2,066,800 | 5,316,172 |
| 1937 | 64,106,000 | 7,756,826 | 13,024,000 | 768,416 | 47,854,000 | 3,110,510 | 14,038,790 |
| 1938 | 40,878,000 | 4,006,044 | 9,898,000 | 455,308 | 56,472,000 | 2,710,656 | 9,473,819 |
| 1848–1938 | [2] 827,976 | 266,154,991 | [2] 230,802 | 22,110,531 | [2] 514,299 | 62,334,762 | 443,868,528 |

[1] Figures not available.
[2] Short tons.

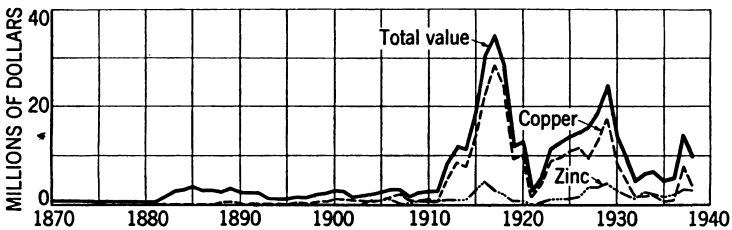


FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1938. The value of gold, silver, and lead produced annually has been relatively small.

*Gold and silver produced at placer mines in New Mexico, 1934–38, in terms of recovered metals*

| Year | Gold | | Silver | | Total value | Year | Gold | | Silver | | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fine ounces | Value | Fine ounces | Value | | | Fine ounces | Value | Fine ounces | Value | |
| 1934 | 2,587.64 | $90,438 | 212 | $137 | $90,575 | 1937 | 3,027.00 | $105,945 | 203 | $157 | $106,102 |
| 1935 | 3,554.40 | 124,404 | 302 | 217 | 124,621 | 1938 | 2,626.00 | 91,910 | 167 | 108 | 92,108 |
| 1936 | 3,378.00 | 118,230 | 235 | 182 | 118,412 | | | | | | |

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*Gold.*—The principal gold-producing districts in New Mexico in 1938 were: Willow Creek (Pecos mine), in San Miguel County, which yielded 32 percent of the State total recoverable output of gold; Mogollon, Catron County, 21 percent; Steeple Rock, Grant County, 13 percent; Lordsburg, Hidalgo County, 8 percent; Mount Baldy, Colfax County, 8 percent; and the Hillsboro district, Sierra County (mostly from placers), 6 percent. The table under the heading Review by Counties and Districts lists all the mining districts of the State that produced in 1938 and shows the production of each district. The principal gold-mining districts of New Mexico are described in Information Circular 6987, issued by the Bureau of Mines.[1] Dry and siliceous ores yielded 49 percent of the total gold; zinc-lead ore, 32 percent; copper ore, 12 percent; and placers, together with a small quantity from lead and lead-copper ores, 7 percent.

*Silver.*—Silver production (in terms of recoverable metal) in New Mexico in 1938 decreased 1 percent from 1937. Substantial increases in the Mogollon, Lordsburg, and Steeple Rock districts were more than offset by a large decrease in the Central district. The Mogollon district produced 35 percent of the State total, Willow Creek 26 percent, Steeple Rock 19 percent, and Lordsburg 11 percent. Dry and siliceous ore, chiefly from the Mogollon and Steeple Rock districts, yielded 59 percent of the total; zinc-lead ore, largely from the Willow Creek and Central districts, 27 percent; copper ore, mostly from the Lordsburg district, 12 percent; and lead-copper and lead ores, together with a very small quantity from placers, 2 percent.

*Copper.*—The Chino Mines Division of the Nevada Consolidated Copper Corporation at Santa Rita produced the bulk of the State output of recoverable copper in 1938 but reduced its production considerably from that of 1937. The total copper output of New Mexico in 1938 decreased 36 percent in quantity and 48 percent in value from 1937. The second-largest producer of copper in the State in 1938 was the Banner Mining Co., operating the Bonney mine 6 miles south of Lordsburg. Most of the remainder of the copper was recovered in concentrates produced from zinc-lead ore of the Pecos mine at Tererro. Copper ore yielded more than 96 percent of the total copper, zinc-lead ore 3 percent, and other types of ore less than 1 percent.

*Lead.*—The production of recoverable lead in New Mexico in 1938 decreased 24 percent in quantity and 41 percent in value from 1937. Most of the decrease in quantity was caused by the shut-down of the Ground Hog-San Jose group and Combination mine in the Central district, Grant County, after April 1938. The Pecos mine in the Willow Creek district, San Miguel County, yielded 86 percent of the State total lead in 1938.

*Zinc.*—The quantity of recoverable zinc in ores and concentrates shipped from New Mexico mines and mills in 1938 increased 18 percent over 1937, but the total value was 13 percent less because of the decline in average price. Two of the large zinc-producing mines—the Pecos at Tererro, San Miguel County, and the Hanover in the Central district, Grant County—were operated continuously in 1938. The Pewabic mine, also in the Central district and an important

[1] Metzger, O. H., Gold Mining in New Mexico: Bureau of Mines Inf. Circ. 6987, 1938, 71 pp.

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producer during the year, was in operation from March to June, inclusive, and from October 15 to December 31. The other mines in New Mexico that produced recoverable zinc in 1938—comprising the Ground Hog-San Jose, Combination, and Peerless groups, also in the Central district; Grandview in the Swartz district, also in Grant County; Waldo at Magdalena, Socorro County; and Iron King in the Kingston district, Sierra County—shipped ore for only a few months in the first part of the year.

## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value |
| Bernalillo | 1 | | 4.40 | $154 | 3 | $2 |
| Catron | 6 | | 8,960.40 | 313,614 | 429,847 | 277,881 |
| Colfax | 4 | 8 | 3,387.40 | 118,559 | 1,205 | 779 |
| Dona Ana | 1 | | 112.60 | 3,941 | 322 | 208 |
| Grant | 70 | 22 | 8,764.80 | 306,768 | 307,426 | 198,740 |
| Hidalgo | 29 | | 4,131.60 | 144,606 | 138,736 | 89,688 |
| Lincoln | 5 | 46 | 167.20 | 5,852 | 458 | 296 |
| Luna | 3 | | 397.40 | 13,909 | 13,676 | 8,841 |
| Otero | | 2 | 11.60 | 406 | 1 | 1 |
| Rio Arriba | 1 | 1 | 7.40 | 259 | 3 | 2 |
| Sandoval | 2 | | 164.20 | 5,747 | 1,700 | 1,099 |
| San Miguel | 1 | | 13,847.20 | 484,652 | 322,400 | 208,420 |
| Santa Fe | 8 | 15 | 321.20 | 11,242 | 2,718 | 1,757 |
| Sierra | 22 | 69 | 2,611.20 | 91,392 | 9,283 | 6,001 |
| Socorro | 10 | | 108.80 | 3,808 | 268 | 173 |
| Taos | 2 | 1 | 38.40 | 1,344 | 1,409 | 911 |
| Torrance | 1 | | 14.20 | 497 | 405 | 262 |
| Total, 1937 | 166 | 164 | 43,050.00 | 1,506,750 | 1,229,860 | 795,061 |
| | 159 | 160 | 41,171.00 | 1,440,985 | 1,243,766 | 962,053 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Bernalillo | | | | | | | $156 |
| Catron | 500 | $49 | | | | | 591,544 |
| Colfax | 27,500 | 2,695 | 300 | $14 | | | 122,047 |
| Dona Ana | 6,500 | 637 | | | | | 4,786 |
| Grant | 33,161,400 | 3,249,817 | 825,400 | 37,968 | 33,421,000 | $1,604,208 | 5,397,501 |
| Hidalgo | 6,380,400 | 625,279 | 159,600 | 7,342 | | | 866,915 |
| Lincoln | 100 | 10 | 5,800 | 267 | | | 6,425 |
| Luna | 6,000 | 588 | 256,700 | 11,808 | | | 35,146 |
| Otero | | | | | | | 407 |
| Rio Arriba | | | | | | | 261 |
| Sandoval | | | | | | | 6,846 |
| San Miguel | 1,184,000 | 116,032 | 8,554,500 | 393,507 | 22,581,000 | 1,083,888 | 2,286,499 |
| Santa Fe | 88,800 | 8,702 | 39,400 | 1,812 | | | 23,513 |
| Sierra | 17,400 | 1,705 | 42,100 | 1,937 | 35,000 | 1,680 | 102,715 |
| Socorro | 700 | 69 | 14,200 | 653 | 435,000 | 20,880 | 25,583 |
| Taos | | | | | | | 2,255 |
| Torrance | 4,700 | 461 | | | | | 1,220 |
| Total, 1937 | 40,878,000 | 4,006,044 | 9,898,000 | 455,308 | 56,472,000 | 2,710,656 | 9,473,819 |
| | 64,106,000 | 7,756,826 | 13,024,000 | 768,416 | 47,854,000 | 3,110,510 | 14,038,790 |

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*Gold and silver produced at lode mines in New Mexico in 1938, by counties, in terms of recovered metals*

| County | Ore sold or treated | Gold | Silver |
|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* |
| Bernalillo | 11 | 4.40 | 3 |
| Catron | 64,855 | 8,960.40 | 429,847 |
| Colfax | 18,941 | 3,337.40 | 1,191 |
| Dona Ana | 133 | 112.60 | 322 |
| Grant | 2,004,701 | 8,580.80 | 307,392 |
| Hidalgo | 113,760 | 4,131.60 | 138,736 |
| Lincoln | 64 | 4.20 | 447 |
| Luna | 3,645 | 397.40 | 13,676 |
| Rio Arriba | 25 | 1.40 | 3 |
| Sandoval | 276 | 164.20 | 1,700 |
| San Miguel | 203,900 | 13,847.20 | 322,400 |
| Santa Fe | 1,374 | 252.00 | 2,715 |
| Sierra | 857 | 470.80 | 9,179 |
| Socorro | 1,239 | 108.80 | 268 |
| Taos | 1,029 | 36.60 | 1,409 |
| Torrance | 47 | 14.20 | 405 |
| | 2,414,857 | 40,424.00 | 1,229,693 |
| Total, 1937 | 4,191,092 | 38,144.00 | 1,243,563 |

*Gold and silver produced at placer mines in New Mexico in 1938, by counties, in fine ounces, in terms of recovered metals*

| County | Sluicing and hydraulic | | Drift mining | | Dry-land dredges[1] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| Colfax | 48.82 | 14 | | | 1.18 | | 50.00 | 14 |
| Grant | 90.27 | 22 | | | 93.73 | 12 | 184.00 | 34 |
| Lincoln | 129.95 | 9 | | | 33.05 | 2 | 163.00 | 11 |
| Otero | 11.60 | 1 | | | | | 11.60 | 1 |
| Rio Arriba | 6.00 | | | | | | 6.00 | |
| Santa Fe | 65.48 | 3 | 3.72 | | | | 69.20 | 3 |
| Sierra | 195.62 | 11 | | | 1,944.78 | 93 | 2,140.40 | 104 |
| Taos | 1.80 | | | | | | 1.80 | |
| | 549.54 | 60 | 3.72 | | 2,072.74 | 107 | 2,626.00 | 167 |
| Total, 1937 | 492.05 | 62 | 19.93 | 3 | 2,515.02 | 138 | 3,027.00 | 203 |

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

## MINING INDUSTRY

Separation of the 166 lode properties producing 2,414,857 tons of ore in New Mexico in 1938 into groups according to quantity of ore sold or treated shows: 10 mines operated by the larger companies, which have invested much money in equipment, maintain staffs of engineers, geologists, and metallurgists, and employ many men, produced 2,392,329 tons of ore; about 30 mines worked by owners, lessees, and small companies, which employed several men and in general used air compressors, air drills, and gasoline or electric hoists (and in some instances operated small ore-reduction mills), produced about 19,150 tons; and the remaining 126 operations, comprising chiefly individuals working alone or in small groups on widely scattered mines, prospects, and dumps and using man power in their operations, produced about 3,378 tons. The ore produced by the 10 mines in the first group yielded 86 percent of the State total output of gold from lode mines, 91 percent of the silver, 93 percent of the lead, 99 percent of the zinc, and more than 99 percent of the copper.

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The output of gold from placers also came mostly from properties equipped for large-scale production; four operators, handling approximately 353,000 cubic yards of gravel during the year and using draglines and power shovels and land washing plants, recovered 79 percent of the State total placer gold. Specific data on yardage handled at small-scale placer operations are not obtainable because of lack of knowledge by the operators of the quantity of gravel sluiced.

### ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore sold or treated in New Mexico in 1938, with content in terms of recovered metals*

| Source | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 26,149 | 7,003.31 | 19,669 | 93,719 | 49,525 | ---------- |
| Dry and siliceous gold-silver ore | 82,017 | 14,011.17 | 697,500 | 37,545 | 210,720 | ---------- |
| Dry and siliceous silver ore | 523 | 4.63 | 7,969 | 1,090 | 3,670 | ---------- |
| | 108,689 | 21,019.11 | 725,138 | 132,354 | 263,915 | ---------- |
| Copper ore | 1,904,374 | 5,337.57 | 150,094 | 39,434,566 | 96,160 | ---------- |
| Lead ore | 962 | 193.12 | 6,258 | 4,030 | 239,125 | ---------- |
| Lead-copper ore | 303 | 13.00 | 11,225 | 45,000 | 161,000 | ---------- |
| Zinc ore | 182,822 | ---------- | ---------- | ---------- | 5,300 | 32,583,000 |
| Zinc-lead ore | 217,707 | 13,861.20 | 336,978 | 1,262,050 | 9,132,500 | 23,889,000 |
| | 2,306,168 | 19,404.89 | 504,555 | 40,745,646 | 9,634,085 | 56,472,000 |
| Total, lode mines | 2,414,857 | 40,424.00 | 1,229,693 | 40,878,000 | 9,898,000 | 56,472,000 |
| Total, placers | ---------- | 2,626.00 | 167 | ---------- | ---------- | ---------- |
| | 2,414,857 | 43,050.00 | 1,229,860 | 40,878,000 | 9,898,000 | 56,472,000 |
| Total, 1937 | 4,191,092 | 41,171.00 | 1,243,766 | 64,106,000 | 13,024,000 | 47,854,000 |

## METALLURGIC INDUSTRY

Most of the ore-reduction plants operating in New Mexico in 1938 were straight flotation mills and were used to treat ores containing all or a large part of their value in copper, lead, and zinc. The Aztec mill in the Mount Baldy district, Colfax County, treated gold-silver-copper ore by flotation but used a jig and amalgam barrel in the ball mill-classifier circuit to recover some of the gold and silver. The Little Fanney mill at Mogollon, Catron County, was the only cyanidation mill in operation in the State during the year.

*Mine production of metals in New Mexico in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore amalgamated | 19,705 | 671.84 | 136 | ---------- | ---------- | ---------- |
| Ore cyanided [1] | 64,352 | 8,604.11 | 424,174 | ---------- | ---------- | ---------- |
| Concentrates smelted | 146,061 | 21,198.54 | 485,661 | 40,567,850 | 9,145,260 | 55,850,000 |
| Ore smelted | 27,808 | 9,949.51 | 319,722 | 310,150 | 752,740 | 622,000 |
| Placer | ---------- | 2,626.00 | 167 | ---------- | ---------- | ---------- |
| | ---------- | 43,050.00 | 1,229,860 | 40,878,000 | 9,898,000 | 56,472,000 |
| Total, 1937 | ---------- | 41,171.00 | 1,243,766 | 64,106,000 | 13,024,000 | 47,854,000 |

[1] Cyanide used was 235,600 pounds of Aero Brand calcium cyanide, approximately 48 to 49 percent NaCN.

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Construction work on the new copper smelter at the Chino concentrator at Hurley, Grant County, which was in progress throughout 1938, was completed early in 1939, and the smelter began treating Chino concentrates May 2. All markets for other New Mexico ore and concentrates are outside the State.

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in New Mexico in 1938, by counties, in terms of recovered metals*

| County | Ore treated | Recovered in bullion | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Catron | 64,352 | 8,604.11 | 424,174 | | | | | |
| Colfax | 18,356 | 474.60 | 77 | 337 | 2,305.85 | 820 | 27,200 | |
| Dona Ana | 41 | 44.60 | 20 | 4 | 9.60 | 27 | 400 | |
| Grant | 785 | 56.31 | 22 | 183 | 53.20 | 1,008 | 1,200 | 23,760 |
| Lincoln | 30 | 3.10 | 1 | | | | | |
| Santa Fe | 415 | 60.68 | 7 | | | | | |
| Sierra | 12 | 16.48 | 2 | | | | | |
| Socorro | 66 | 16.07 | 7 | (1) | 1.10 | 1 | | |
| | 84,057 | 9,275.95 | 424,310 | 524 | 2,369.75 | 1,856 | 28,800 | 23,760 |
| Total, 1937 | 77,209 | 8,348.78 | 258,167 | 23 | 118.86 | 70 | | 200 |

[1] Less than ½ ton.

*Mine production of metals from concentrating mills in New Mexico in 1938, by counties, in terms of recovered metals*

| County | Ore treated | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|
| | | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Grant | 1,986,253 | 95,120 | 1,875.00 | 39,001 | 33,025,000 | 434,000 | 33,234,000 |
| Hidalgo | 111,529 | 13,186 | 3,065.79 | 119,145 | 6,327,000 | 93,000 | |
| Rio Arriba | 25 | 1 | 1.40 | 3 | | | |
| San Miguel | 203,900 | 37,104 | 13,847.20 | 322,400 | 1,184,000 | 8,554,500 | 22,581,000 |
| Sierra | 254 | 103 | 2.00 | 2,162 | 3,050 | 40,000 | 35,000 |
| Socorro | 15 | 1 | 12.30 | 79 | | | |
| Taos | 1,016 | 22 | 25.10 | 1,015 | | | |
| | 2,302,992 | 145,537 | 18,828.79 | 483,805 | 40,539,050 | 9,121,500 | 55,850,000 |
| Total, 1937 | 4,057,612 | 173,807 | 22,121.19 | 621,941 | 61,485,020 | 11,379,850 | 46,270,000 |

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*Gross metal content of concentrates produced from ores mined in New Mexico in 1938, by classes of concentrates smelted*

| Class of concentrates | Concentrates produced | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper (wet assay) | Lead (wet assay) | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 16 | 23.00 | 120 | 443 | 382 | |
| Dry gold-silver | 22 | 25.10 | 1,015 | 57 | 9 | |
| Copper | 72,605 | 7,244.24 | 146,577 | 40,709,154 | 187,189 | |
| Lead | 235 | 47.00 | 2,863 | 5,894 | 69,893 | 19,038 |
| Lead-copper | 12,749 | 13,070.30 | 280,543 | 1,070,962 | 9,986,640 | 2,830,645 |
| Zinc | 60,434 | 1,195.40 | 90,962 | 506,047 | 554,897 | 65,705,428 |
| | 146,061 | 21,605.04 | 522,080 | 42,292,557 | 10,799,010 | 68,555,111 |
| Total, 1937 | 173,830 | 22,737.81 | 681,893 | 65,051,836 | 13,564,988 | 59,808,582 |

*Mine production of metals from New Mexico concentrates shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Colfax | 337 | 2,305.85 | 820 | 27,200 | | |
| Dona Ana | 4 | 9.60 | 27 | 400 | | |
| Grant | 95,303 | 1,928.20 | 40,009 | 33,026,200 | 457,760 | 33,234,000 |
| Hidalgo | 13,186 | 3,065.79 | 119,145 | 6,327,000 | 93,000 | |
| Rio Arriba | 1 | 1.40 | 3 | | | |
| San Miguel | 37,104 | 13,847.20 | 322,400 | 1,184,000 | 8,554,500 | 22,581,000 |
| Sierra | 103 | 2.00 | 2,162 | 3,050 | 40,000 | 35,000 |
| Socorro | 1 | 13.40 | 80 | | | |
| Taos | 22 | 25.10 | 1,015 | | | |
| | 146,061 | 21,198.54 | 485,661 | 40,567,850 | 9,145,260 | 55,850,000 |
| Total, 1937 | 173,830 | 22,240.05 | 622,011 | 61,485,020 | 11,380,050 | 46,270,000 |

BY CLASSES OF CONCENTRATES SMELTED

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 16 | 23.00 | 120 | 400 | 340 | |
| Dry gold-silver | 22 | 25.10 | 1,015 | | | |
| Copper | 72,605 | 7,244.24 | 146,577 | 39,304,600 | 93,000 | |
| Lead | 235 | 47.00 | 2,863 | 3,850 | 63,420 | |
| Lead-copper | 12,749 | 13,070.30 | 280,543 | 858,000 | 8,988,500 | |
| Zinc | 60,434 | 788.90 | 54,543 | 401,000 | | 55,850,000 |
| | 146,061 | 21,198.54 | 485,661 | 40,567,850 | 9,145,260 | 55,850,000 |

*Gross metal content of New Mexico crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | | Gross metal content | | | | |
|---|---|---|---|---|---|---|---|
| | | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Percent of total* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 7,161 | 25.75 | 4,047.75 | 18,622 | 70,226 | 91,994 | 4,012 |
| Dry and siliceous gold-silver | 15,892 | 57.15 | 5,282.23 | 271,284 | 40,603 | 214,383 | 1,229 |
| Dry and siliceous silver | 523 | 1.88 | 4.63 | 7.969 | 1.282 | 6.480 | |
| Copper | 1,383 | 4.97 | 408.78 | 4,364 | 163,594 | 6,102 | |
| Lead | 962 | 3.46 | 193.12 | 6,258 | 5,820 | 266,217 | 5,342 |
| Lead-copper | 303 | 1.09 | 13.00 | 11,225 | 56,558 | 178,642 | 83,806 |
| Zinc | 983 | 3.54 | | | | 7,556 | 543,531 |
| Zinc-lead | 601 | 2.16 | | | | 148,934 | 233,810 |
| | 27,808 | 100.00 | 9,949.51 | 319,722 | 338,083 | 920,308 | 871,730 |
| Total, 1937 | 56,271 | 100.00 | 7,555.57 | 363,509 | 2,659,764 | 2,776,520 | 4,245,424 |

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*Mine production of metals from New Mexico crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Bernalillo | 11 | 4.40 | 3 | | | |
| Catron | 503 | 356.29 | 5,673 | 500 | | |
| Colfax | 585 | 556.95 | 294 | 300 | 300 | |
| Dona Ana | 92 | 58.40 | 275 | 6,100 | | |
| Grant | 17,663 | 6,596.29 | 267,361 | 135,200 | 367,640 | 187,000 |
| Hidalgo | 2,231 | 1,065.81 | 19,591 | 53,400 | 66,600 | |
| Lincoln | 34 | 1.10 | 446 | 100 | 5,800 | |
| Luna | 3,645 | 397.40 | 13,676 | 6,000 | 256,700 | |
| Sandoval | 276 | 164.20 | 1,700 | | | |
| Santa Fe | 959 | 191.32 | 2,708 | 88,800 | 39,400 | |
| Sierra | 591 | 452.32 | 7,015 | 14,350 | 2,100 | |
| Socorro | 1,158 | 79.33 | 181 | 700 | 14,200 | 435,000 |
| Taos | 13 | 11.50 | 394 | | | |
| Torrance | 47 | 14.20 | 405 | 4,700 | | |
| | 27,808 | 9,949.51 | 319,722 | 310,150 | 752,740 | 622,000 |
| Total, 1937 | 56,271 | 7,555.17 | 363,385 | 2,620,980 | 1,643,950 | 1,584,000 |

BY CLASSES OF ORE

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry and siliceous gold | 7,161 | 4,047.75 | 18,622 | 66,119 | 49,525 | |
| Dry and siliceous gold-silver | 15,892 | 5,282.23 | 271,284 | 36,345 | 186,960 | |
| Dry and siliceous silver | 523 | 4.63 | 7,969 | 1,090 | 3,670 | |
| Copper | 1,383 | 408.78 | 4,364 | 157,566 | 3,160 | |
| Lead | 962 | 193.12 | 6,258 | 4,030 | 239,125 | |
| Lead-copper | 303 | 13.00 | 11,225 | 45,000 | 161,000 | |
| Total to copper and lead plants | 26,224 | 9,949.51 | 319,722 | 310,150 | 643,440 | |
| Zinc | 983 | | | | 5,300 | 435,000 |
| Zinc-lead | 601 | | | | 104,000 | 187,000 |
| | 27,808 | 9,949.51 | 319,722 | 310,150 | 752,740 | 622,000 |



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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1938, by counties and districts, in terms of recovered metals*

| County and district | Mines producing | | Ore sold or treated | Gold | | | Silver | | | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | Lode | Placer | Total | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Bernalillo County: Coyote | 1 | | 11 | 4.40 | | 4.40 | 3 | | 3 | | | | $156 |
| Catron County: Mogollon | 6 | | 64,855 | 8,960.40 | | 8,960.40 | 429,847 | | 429,847 | 500 | | | 591,544 |
| Colfax County: Mount Baldy | 4 | 8 | 18,941 | 3,337.40 | 50.00 | 3,387.40 | 1,191 | 14 | 1,205 | 27,500 | 300 | | 122,047 |
| Dona Ana County: Organ | 1 | | 133 | 112.60 | | 112.60 | 322 | | 322 | 6,500 | | | 4,786 |
| Grant County: | | | | | | | | | | | | | |
| Burro Mountain | 5 | | 338 | 230.80 | | 230.80 | 8,186 | | 8,186 | 1,100 | 200 | | 13,487 |
| Central | 10 | 3 | 1,987,688 | 2,029.40 | 9.20 | 2,038.60 | 52,645 | 3 | 52,648 | 33,114,400 | 679,500 | 33,389,000 | 4,984,526 |
| Gold Hill [1] | 5 | | 17 | 7.20 | | 7.20 | 187 | | 187 | | 400 | | 391 |
| Lone Mountain | 1 | | 1 | | | | 68 | | 68 | | | | 44 |
| Pinos Altos | 35 | 15 | 1,834 | 626.60 | 76.40 | 703.00 | 7,176 | 19 | 7,195 | 11,900 | 81,800 | | 34,185 |
| Red Rock | 2 | | 3 | | | | 11 | | 11 | 700 | | | 76 |
| Steeple Rock | 11 | | 14,740 | 5,686.80 | | 5,686.80 | 239,119 | | 239,119 | 33,300 | 38,500 | | 358,654 |
| Swartz | 1 | | 80 | | | | | | | | 25,000 | 32,000 | 2,686 |
| White Signal | | 4 | | | 98.40 | 98.40 | | 12 | 12 | | | | 3,452 |
| Hidalgo County: | | | | | | | | | | | | | |
| Gillespie | 1 | | 143 | 2.60 | | 2.60 | 1,488 | | 1,488 | 700 | 23,300 | | 2,194 |
| Gold Hill [1] | 3 | | 69 | 23.60 | | 23.60 | 51 | | 51 | 100 | 3,700 | | 1,039 |
| Lordsburg | 20 | | 112,157 | 3,402.40 | | 3,402.40 | 134,849 | | 134,849 | 6,346,300 | 113,200 | | 833,403 |
| San Simon | 1 | | [15] | 59.60 | | 59.60 | 20 | | 20 | | 100 | | 2,104 |
| Sylvanite | 4 | | 1,376 | 643.40 | | 643.40 | 2,328 | | 2,328 | 33,300 | 19,300 | | 28,175 |
| Lincoln County: | | | | | | | | | | | | | |
| Jicarilla | | 45 | | | 162.20 | 162.20 | | 11 | 11 | | | | 5,684 |
| Nogal | 4 | | 41 | 3.20 | | 3.20 | 195 | | 195 | | 2,300 | | 344 |
| White Oaks | 1 | 1 | 23 | 1.00 | .80 | 1.80 | 252 | | 252 | 100 | 3,500 | | 397 |
| Luna County: | | | | | | | | | | | | | |
| Cooks Peak | 2 | | 50 | | | | 393 | | 393 | | 46,700 | | 2,402 |
| Victorio | 1 | | 3,595 | 397.40 | | 397.40 | 13,283 | | 13,283 | 6,000 | 210,000 | | 32,744 |
| Otero County: Orogrande | | 2 | | | 11.60 | 11.60 | | 1 | 1 | | | | 407 |
| Rio Arriba County: Headstone | 1 | 1 | 25 | 1.40 | 6.00 | 7.40 | 3 | | 3 | | | | 261 |
| Sandoval County: Cochiti | 2 | | 276 | 164.20 | | 164.20 | 1,700 | | 1,700 | | | | 6,846 |
| San Miguel County: Willow Creek | 1 | | 203,900 | 13,847.20 | | 13,847.20 | 322,400 | | 322,400 | 1,184,000 | 8,554,500 | 22,581,000 | 2,286,499 |

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| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Santa Fe County: | | | | | | | | | | | | | | | | |
| Ortiz Mountains (Cerrillos) | 1 | 5 | 32 | 16.80 | 5.00 | 21.80 | 20 | | 20 | 300 | | | | | | 805 |
| San Pedro | 7 | 10 | 1,342 | 235.20 | 64.20 | 299.40 | 2,695 | 3 | 2,698 | 88,500 | 39,400 | | | | | 22,708 |
| Sierra County: | | | | | | | | | | | | | | | | |
| Chloride | 4 | | 20 | 42.20 | | 42.20 | 594 | | 594 | 100 | 400 | | | | | 1,889 |
| Kingston | 3 | | 540 | 3.80 | | 3.80 | 6,367 | | 6,367 | 3,300 | 40,600 | 35,000 | | | | 8,120 |
| Lake Valley | 1 | | 29 | | | | 215 | | 215 | 100 | 1,100 | | | | | 200 |
| Las Animas (Hillsboro) | 14 | 32 | 268 | 424.80 | 2,072.80 | 2,497.60 | 2,003 | 101 | 2,104 | 13,900 | | | | | | 90,138 |
| Pittsburg | | 37 | | | 67.60 | 67.60 | | 3 | 3 | | | | | | | 2,368 |
| Socorro County: | | | | | | | | | | | | | | | | |
| Good Fortune | 1 | | 2 | | | | 1 | | 1 | 550 | | | | | | 55 |
| Hansonberg | 1 | | 4 | .11 | | .11 | 11 | | 11 | | 3,000 | | | | | 149 |
| Magdalena | 6 | | 1,181 | 79.49 | | 79.49 | 163 | | 163 | 150 | 11,200 | 435,000 | | | | 24,297 |
| San Mateo Mountains | 2 | | 52 | 29.20 | | 29.20 | 93 | | 93 | | | | | | | 1,082 |
| Taos County: Red River | 2 | 1 | 1,029 | 36.60 | 1.80 | 38.40 | 1,409 | | 1,409 | | | | | | | 2,255 |
| Torrance County | 1 | | 47 | 14.20 | | 14.20 | 405 | | 405 | 4,700 | | | | | | 1,220 |
| Total New Mexico | 166 | 164 | 2,414,857 | 40,421.00 | 2,626.00 | 43,050.00 | 1,229,693 | 167 | 1,229,830 | 40,878,000 | 9,898,000 | 56,472,000 | | | | 9,473,819 |

[1] District lies in both Grant and Hidalgo Counties.

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### BERNALILLO COUNTY

*Coyote district.*—Sinking of a 10-foot shaft on each of four newly discovered claims 14 miles east of Albuquerque in sec. 6, T. 9 N., R. 5 E., New Mexico principal meridian, resulted in the shipment of 11 tons of oxidized gold ore to the El Paso smelter in 1938.

### CATRON COUNTY

*Mogollon district.*—The Mogollon was the largest silver-producing district in New Mexico in 1938 and ranked second in gold production. The output of silver increased from 310,450 fine ounces in 1937 to 429,847 ounces in 1938, and gold from 7,559 to 8,960 ounces. The Black Hawk Consolidated Mines Co., the only larger operator in the district in 1938, maintained steady shipments of gold-silver bullion to the Denver Mint throughout the year from the Little Fanney 200-ton cyanide mill at Mogollon. The company holds the mill and the Consolidated group, comprising the Andrew Jackson Consolidated, Lexington Contention, and Lexington Gunboat claims on the Queen vein, under lease from the Lehigh Metals Co. The mill treated 64,352 tons of ore in 1938 compared with 45,508 tons in 1937. In 1938 the mill feed included 4,135 tons of custom ore from the Maud S group and 2,312 tons from the Last Chance, both worked by lessees—the Maud S for the entire year and the Last Chance from April 1 to December 31. Some of the ore produced at the Last Chance group was shipped crude to the El Paso smelter. The 150-ton Deadwood flotation mill, which was run part of 1937 by the Mogollon Consolidated Mines Co., was idle all of 1938. The Bearup mine was operated on a small scale during January, February, and March 1938 and produced about 60 tons of ore, of which 21 tons containing 4.43 ounces of gold and 164 ounces of silver were shipped to the El Paso smelter during the year. Small lots of ore were shipped from two other claims in the district in 1938.

### COLFAX COUNTY

*Mount Baldy district (Baldy, Elizabethtown, Eagle Nest).*—The Aztec mine, owned and operated by the Maxwell Land Grant Co., continued in 1938 to be the principal producer in the Mount Baldy district. The ore was treated in the company 140-ton flotation mill. During the year the company installed a jig in the ball mill-classifier circuit and an amalgam barrel to treat the jig concentrates. The yield from 17,831 tons of newly mined ore and 525 tons taken from dumps was 337 tons of concentrates, containing 2,305.85 ounces of gold, 820 ounces of silver, and 28,288 pounds of copper, shipped to the El Paso smelter and amalgam retorts and metallics, containing 474.60 fine ounces of gold and 77 ounces of silver, shipped to the Denver Mint. Some of the ore treated came from the Montezuma mine and Ponil group dumps. Additional ore from the Montezuma mine, operated continuously by I. E. Pippert under lease from the Maxwell Land Grant Co., was shipped to the El Paso smelter. A lessee at the Virginia Hutchinson mine, also owned by the Maxwell Land Grant Co., shipped 2 tons of smelting ore and recovered a few ounces of gold by hand methods. The French Henry mine was under develop-

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ment from July to December. Some placer mining was done on Willow, Ute, and South Ponil Creeks.

### DONA ANA COUNTY

*Organ district.*—The Mormon mine was operated on a small scale in 1938. It is opened by three shafts—one 205 feet, one 150 feet, and one 110 feet deep—but they were accessible in 1938 only to the water level 90 feet from the surface. Stoping and drifting above the water level yielded 48 tons of ore, most of which was treated in a 6-ton amalgamation mill at the mine. The remainder of the ore and some old tailings from previous operations were shipped to the El Paso smelter.

### GRANT COUNTY

*Burro Mountain district (Tyrone).*—The Standard Silver Lead Mining Co. purchased the Malone mine in January 1938 and operated it to the end of the year. The company did 880 feet of development work and shipped gold-silver ore to the El Paso smelter. Small lots of ore were shipped from the Calcutta, Little Wonder, Petanke, and Shamrock properties.

*Central district (Bayard, Fierro, Georgetown, Hanover, Santa Rita).*—The Chino open-pit mine of the Nevada Consolidated Copper Corporation, an operating subsidiary of the Kennecott Copper Corporation, at Santa Rita is the largest producer of copper in New Mexico. The ore is mined with electric shovels, 11 of which were in use in 1938, and is transported 10 miles over the Atchison, Topeka & Santa Fe Ry. to the company 15,000-ton flotation mill at Hurley for treatment. The concentrates produced contain, besides copper, a little gold and silver and some molybdenite. The separation of molybdenite from the copper concentrates at Chino was first reported in the annual report of the Kennecott Copper Corporation for 1937. The Twenty-Fourth Annual Report of the Kennecott Copper Corporation, dated March 21, 1939, contains the following paragraphs pertaining to its domestic mining operations and Chino property in 1938:

> A total of 16,681,931 tons of ore having a calculated average assay of 1.10 percent copper was treated at the five domestic properties of the Corporation. Copper production amounted to 334,816,884 pounds, a reduction of about 44 percent compared to the 598,733,371 pounds produced in 1937. A relatively heavy stripping program carried on at the power shovel properties in Utah, Nevada, and New Mexico resulted in the removal of approximately 30,225,000 tons of noncommercial overburden. In terms of ratio, 1.95 tons of overburden were removed for each ton of ore mined by shovels at these properties in 1938 whereas in 1937 the ratio was 1.10 tons to 1.
>
> Copper production at the Chino property in New Mexico was suspended from June 22 until October 15 and during the remainder of the year was curtailed in keeping with the general production policy. The new coarse-crushing plant and car dumper operated efficiently. A number of new wells were drilled and a water supply developed which is adequate for the treatment of fully 20,000 tons of ore per day. Construction of the new smelter has progressed without interruption and will be completed in advance of the expiration on March 22, 1939, of the contract with the El Paso smelter which provides that all concentrates produced prior to expiration be shipped to El Paso. Consequently it will probably be May 1 before sufficient concentrates can be accumulated to form a working stock for the steady operation of the new plant. Capital expenditures at the Chino property amounted to $2,622,000, most of this representing outlay on the new smelter.

The Hanover zinc mine and 300-ton flotation mill of the Empire Zinc Co. were operated continuously in 1938. The concentrates

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produced were shipped to plants of the New Jersey Zinc Co. at Palmerton, Pa., and Depue, Ill. (Mineral Point Zinc Division); to the American Zinc Co., East St. Louis, Ill. (for roasting); and to the American Zinc & Chemical Co., Langeloth, Pa. The Peru Mining Co. operated its Pewabic mine at Hanover and 500-ton mill at Wemple near Deming during March, April, May, and June 1938 and then suspended production. The property was shut down until October 15, when the mine and mill were leased to the Callahan Zinc-Lead Co., which operated them to the end of the year. The mill product is lead-free zinc concentrates, which are roasted at Wemple and shipped to the zinc smelter of the Illinois Zinc Co. (parent company of the Peru Mining Co.) at Dumas, Tex. The mine and mill were again shut down early in 1939 and were still idle when this report was written (May 1939).

The Ground Hog and San Jose mines, operated as a unit by the American Smelting & Refining Co. for the past 10 years, have been important producers of silver, lead, zinc, and copper, and a large part of the ore has been treated in custom mills. In April 1938 the company ceased shipping to the 200-ton Combination custom mill of the Black Hawk Consolidated Mines Co. at Hanover, which had received the bulk of its mill feed from these mines since 1930, and as a result the mill was closed. The Combination mine, operated by the Black Hawk Consolidated Mines Co. from January to April 30, also was closed. Later in 1938 the American Smelting & Refining Co. leased the mill and made some changes necessary for the handling of Ground Hog ore which changed somewhat in character as development proceeded downward to the 1,600-foot level. In April 1939 the mill was placed in operation on company and custom ores. The Peerless Mining & Milling Co. continued developing the Peerless mine from January to June 1938 and shipped zinc-lead-silver ore to the Combination mill and zinc-lead ore to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans. From July 1 to the end of the year the development work was financed by the American Smelting & Refining Co. under an option to purchase. Development as of January 1, 1939, comprised a 330-foot shaft and 1,395 feet of drifts and crosscuts. Ore was shipped direct to smelters from the Hanover-Bessemer Iron & Copper Co. group, Gold Frog group, and one other property in the Central district. Elayer & Matthews, working the Cash and Gold Spot claims near Vanadium, recovered a few ounces of gold by washing ore in a sluice box and also mined some ore to be shipped to the smelter in 1939. Individuals recovered a little gold from small placers in 1938.

*Gold Hill district* (*see also Hidalgo County*).—Small lots of ore were shipped in 1938 from the Old Spanish, Robert Lee, Silver Dollar, and Yellow Queen claims and a prospect in the Gold Hill district to the El Paso smelter, to Ira L. Wright at Silver City, and to Hawley & Hawley at Douglas, Ariz.

*Lone Mountain district.*—A lessee at the My Chance claim shipped a 1-ton lot of silver ore in 1938.

*Pinos Altos district.*—The metal output of the Pinos Altos district in 1938 was derived chiefly from ore produced by many small-scale operations and shipped direct to the El Paso smelter or sold in small lots to Ira L. Wright at Silver City and Hawley & Hawley at Douglas, Ariz. The Calumet 20-ton gravity-concentration mill was operated by lessees part of the year as a custom plant and treated about 580

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tons of ore from the Mammouth tailings dump and Campo Santo and Mountain Key mine dumps and 180 tons from the Silver Hill and Ohio mines. Remodeling of the mill to include flotation was completed early in 1939. Other producing mines and dumps included the Bonanza No. 3, Florence, Geo. Schafer, Golden Rule, Hazard, Houston-Thomas, Kept Woman, Langston, Lupita group, Oak Grove, Rich Gulch, and Wild Horse. Individuals continued to work small placers near Pinos Altos intermittently with rockers and sluices.

*Red Rock district.*—Three tons of copper-silver ore—2 tons from the Friendship claim and 1 ton from the Good Luck—were shipped from the Red Rock district in 1938.

*Steeple Rock district.*—Shipments of dry and siliceous gold-silver ore from the Steeple Rock district to smelters in Arizona and Texas were continued in 1938. Production from the East Camp group, operated throughout the year by the East Camp Exploration Syndicate, was 8,029 tons of ore averaging 0.36 ounce of gold and 23.71 ounces of silver to the ton; the ore also contains a little copper and lead. The mine is developed by a vertical shaft 300 feet deep, 100 feet of winzes, 1,400 feet of raises, and 3,000 feet of drifts. Veta Mines, Inc., continued to ship newly mined ore and old tailings from the Carlisle group. The ore contains principally gold and silver, with minor quantities of pyrite, galena, chalcopyrite, and sphalerite. As the ore shipped in 1938 went to copper smelters none of the zinc was saved. The section of the mine from which production was made in 1938 is opened by an incline shaft 140 feet deep, 500 feet of drifting, and a 90-foot winze. The old workings on the property were not reopened. Lessees at the Alabama and Laura mines shipped a substantial quantity of ore during the year. Other producers of a car or more of ore in 1938 included the Gold King, Norman King, and Twin Peaks mines.

*Swartz (or Carpenter or Camp Monarch) district.*—The Black Range Development Co. drove 200 feet of tunnel at the Grandview group 30 miles east of Santa Rita and shipped 80 tons of ore, containing 35,662 pounds of lead and 39,826 pounds of zinc, to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans.

*White Signal district.*—Placer ground of Sunset Gold Fields, Inc., in Gold Gulch was under development by a lessee from February 1 to December 31, 1938. The property is equipped with a power shovel and portable Ainlay bowl recovery plant, which was run for a period and produced nearly all the metal output of the White Signal district in the year. The remainder was recovered by individuals sluicing at small placers in the same area.

### HIDALGO COUNTY

*Apache district.*—The development work begun in 1937 by the United States Smelting, Refining & Mining Exploration Co. on the Monarch and Copper Crown claims of the Apache group was continued to June 3, 1938, when work was discontinued and the lease terminated.

*Gillespie district.*—The Red Hill Mining Co. operated the Red Hill group, opened by a 500-foot vertical shaft and several thousand feet of drifts and crosscuts, from July 1 to September 1, 1938, and shipped lead-silver-gold ore to the El Paso smelter.

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*Gold Hill district* (*see also Grant County*).—The Sweet Mining Co. shipped 62 tons of gold-silver-lead ore from a prospect to the El Paso smelter in 1938. The remainder of the output of the Gold Hill district comprised 2 tons of gold-silver ore from the Big Chief claim and 5 tons of gold-silver-lead ore from the Oro Grande.

*Lordsburg district.*—The Banner Mining Co. operated the Bonney mine and flotation mill 6 miles south of Lordsburg continuously in 1938. Although the company maintained production at a higher rate than in 1937, it proceeded with development of the lower levels of the mine and sank the vertical main shaft an additional 150 feet, giving it a total depth of 1,020 feet at the end of 1938; development work done during the year totaled 6,272 feet. The product of the mill is copper-gold-silver-[iron] concentrates, which are sold to the El Paso smelter. Lessees working the Belle, Depression, Nellie Bly, Silver Dollar, and other properties in the Lordsburg district on a small scale continued to make intermittent shipments of newly mined and sorted dump ore to the El Paso smelter and to Hawley & Hawley at Douglas, Ariz.

*San Simon district* (*Steins*).—Prospecting and development were continued at the Paint Horse group in 1938, and small lots of high-grade gold ore were shipped.

*Sylvanite district.*—The Sylvanite Gold Mining Co. operated its Buckhorn-Barney-Woods group 16 miles southwest of Hachita from January 1 to December 15, 1938. Most of the ore produced was shipped direct to the El Paso smelter. The mine is opened by a vertical shaft 200 feet deep, a tunnel, and drifts. It is equipped with a 20-ton concentration mill. A car of silver-lead ore from the Eagle claim and small lots of the same type of ore from the Last Chance and Dodge claims were shipped to the El Paso smelter.

### LINCOLN COUNTY

*Jicarilla district.*—Placer miners continued to recover gold by rocking, sluicing, and drift mining in 1938 in the Jicarilla Mountains southeast of Ancho. At a few placers machinery was used to handle the gravel. Most of the gold produced was sold in small lots to merchants at Jicarilla and Ancho.

*Nogal district.*—During July 1938 Great Western Mines, Inc., treated in a small amalgamation mill 30 tons of ore from an open-cut on its property. Only 11 tons of ore were shipped to smelters from mines and prospects in the Nogal district in 1938.

*White Oaks district.*—The Lincoln County Mining & Milling Co. shipped a car of lead-silver-gold-copper ore to the El Paso smelter in 1938, and a little gold was recovered at a placer mine in the White Oaks district.

### LUNA COUNTY

*Cooks Peak district.*—Lead-silver ore was shipped in 1938 from the Lookout mine and Ethel-"85" group to the El Paso smelter and to Ira L. Wright at Silver City.

*Deming.*—The Peru 500-ton selective flotation mill at Wemple near Deming was operated in 1938 by the Peru Mining Co. at an average daily rate of 330 tons from March to June, inclusive; it was idle from July to October 15, when it was started up under lease by the Callahan Zinc-Lead Co. and treated an average of 323 tons daily to the

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end of the year. The ore treated by both companies was lead-free zinc sulfide ore from the Pewabic mine at Hanover, Grant County.

*Victorio district.*—In 1938 Shanks Carpenter continued to ship oxidized gold-silver-lead-[zinc]-iron-lime ore from the Victorio group 4 miles south of Gage to the El Paso smelter. The mine is developed by a 300-foot vertical shaft, a 700-foot adit, and 4,000 feet of other workings.

### OTERO COUNTY

*Orogrande district.*—A lessee worked the Center placer with a dry washer and pan from January 1 to April 15, 1938, and recovered 6.50 ounces of dust 0.915 fine in gold. About the same quantity of gold was recovered from another placer in the Orogrande district in 1938.

### RIO ARRIBA COUNTY

*Headstone district.*—The A. J. S. Mining Co. erected a mill at the Badger-Hidden Treasure group in 1938 and operated it for a short period late in the year. An individual prospecting on placer ground near Tres Piedras recovered a little placer gold.

### SANDOVAL COUNTY

*Cochiti (Bland) district.*—Lessees shipped several cars of gold-silver ore from the Lone Star mine to the El Paso smelter in 1938. A lessee at the old Cossak cyanidation mill cleaned up and shipped to the smelter 4 tons of high-grade gold- and silver-bearing material.

### SAN MIGUEL COUNTY

*Willow Creek district (Tererro).*—The Pecos mine of the American Metal Co. of New Mexico was operated continuously in 1938, its twelfth year of production. The mine has been productive to a depth of 1,700 feet, but the levels below 1,200 feet were abandoned prior to 1938 and operations during 1938 were conducted on levels 1,200 to 400, inclusive. The flow of water continued at an average rate of 1,800 gallons per minute, most of which was pumped from the 1,200-foot level. The ore is treated in the company 600-ton selective flotation mill in Alamitos Canyon. The mill feed in 1938 was 203,900 tons of ore averaging 0.086 ounce of gold and 2.27 ounces of silver to the ton, 0.51 percent copper (wet assay), 2.99 percent lead (wet assay), 8.07 percent zinc, and 11.32 percent iron. The yield was 24,819 tons of zinc concentrates—averaging 0.048 ounce of gold and 3.53 ounces of silver to the ton, 0.96 percent copper (wet assay), 1.03 percent lead (wet assay), 53.52 percent zinc, and 7.53 percent iron—and 12,285 tons of lead-copper concentrates—averaging 1.06 ounces of gold and 21.96 ounces of silver to the ton, 4.08 percent copper (wet assay), 38.68 percent lead (wet assay), 11.08 percent zinc, and 12.32 percent iron. On May 31, 1939, the mine was closed.

### SANTA FE COUNTY

*Ortiz Mountains district (Cerrillos).*—A small output of gold-silver ore was made from the Chord mine in 1938, and some gold was recovered at small placers in the Ortiz Mountains district.

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*San Pedro or New Placers district.*—Lessees at the San Pedro copper mine on the south slope of the San Pedro Mountains 20 miles west of Stanley continued to ship copper-gold-silver ore to the El Paso smelter in 1938. In the first part of the year the mine was purchased by John J. Raskob, who had made geophysical and geological examinations of the mine followed by diamond drilling in 1939. A lessee at the Lincoln-Lucky-Amazon group shipped several cars of lead-silver-gold-copper ore. A few tons of copper-gold-silver ore were shipped from the Delgado and other properties in the San Pedro district. Ore from the Old Timer dump and Captain Davis claim was treated in small amalgamation mills. Most of the output from placers in 1938 was made by lessees sluicing at the Lazarus placer. Individuals continued to recover small lots of dust from other placers.

### SIERRA COUNTY

*Chloride (Apache, Cuchillo Negro) district.*—In 1938 individuals residing at Winston hauled a few truckloads of ore obtained from leasing and prospecting operations in the Chloride district to the El Paso smelter.

*Kingston district.*—During the first few months of 1938 the lessee on the Iron King mine in the Kingston group of the Empire Zinc Co. continued to ship zinc-lead-silver-copper ore to the Black Hawk Consolidated Mines Co. concentrator at Hanover, Grant County, for treatment. J. H. Moffitt, owner of the Cumberland group, shipped about 7 cars of silver-gold-lead-copper ore to the El Paso smelter. A 2-ton lot of lead ore was shipped to the smelter from another property in the Kingston district.

*Lake Valley district.*—A car of silver-lead-copper ore was shipped from the Lake Valley group to the El Paso smelter in 1938.

*Las Animas district (Hillsboro).*—The chief producer of gold in the Las Animas district in 1938, as in each year since 1934, was the John I. Hallett Construction Co. placer operation on a consolidated group of leased properties (including the Gold Dust, Graf Von Luxemburg, and others), 8 miles east of Hillsboro. The equipment consists of two gasoline-powered dragline excavators of 1 and 1¼ cubic yards capacity, a Coulter-Ainlay four-bowl recovery plant mounted on wheels, water-storage tanks, and pumps. Clarence Berg operated a ¾-cubic yard dragline and home-made portable dry-washing plant at the Gordon-Sylvia (or Wilder) placer from March 29 to May 27 and recovered 76 fine ounces of gold. Sluicing, panning, and dry washing at small placers produced some gold.

The Wicks lode mine in Wicks Gulch was shut down from January 1 to October 27, 1938; then it was leased to Drunzer & Everhart, who shipped some ore to the El Paso smelter before the end of the year. Small-scale operations, mostly by lessees, at the Biglow, Bonanza, Duke, El Oro, Gold Coin, Litel King, Lucky Strike, M. K. T., Ready Pay, Sherman, and other properties in the Hillsboro district yielded many small lots of gold-silver-copper ore, which were sold to the El Paso smelter, to Hawley & Hawley at Douglas, Ariz., and to Ira L. Wright at Silver City, N. Mex.

*Pittsburg district.*—Most of the output of gold and silver from the Pittsburg district in 1938 was contained in small lots of placer dust

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recovered by individuals sluicing and panning over a considerable area; the dust was marketed through a general store at Hatch.

### SOCORRO COUNTY

*Good Fortune district (40 miles west of Tularosa).*—A lessee worked the Belle Vista prospect during July and August 1938 and shipped a 2-ton lot of oxidized copper ore to the El Paso smelter.

*Hansonberg district* (17 miles southeast of Carthage).—In 1938 one of the owners of the Louise-Halsbad group worked at the property 30 days in May and June and 6 days in November. The ore shipped contained about 43 percent lead and 2.50 ounces of silver and 0.025 ounce of gold to the ton.

*Magdalena district.*—During January and February 1938 lessees at the Waldo mine of the Ozark Smelting & Mining Co. continued to ship zinc ore to the company pigment plant at Coffeyville, Kans.; the mine was idle from March to the end of the year. The Mistletoe mine was worked by lessees for a period and produced most of the gold-silver-lead ore shipped from the Magdalena district in 1938. A few lots of ore were shipped from prospects during the year.

*San Mateo Mountains district.*—The Panky group of the Springtime Mining Co., closed late in 1936, was idle until the last quarter of 1938 when a lessee did some repair work and made several test runs in the mill, resulting in the shipment of about a ton of high-grade gold-silver concentrates. Ellison Warren worked his claim from January to August and installed a 10-ton amalgamation-gravity concentration mill which he removed after having treated a small quantity of ore; he also shipped some gold-silver ore to the El Paso smelter.

### TAOS COUNTY

*Red River district.*—The Memphis mine was operated by a lessee from January to March 1938. The ore produced was treated in a 30-ton gravity- and flotation-concentration mill at Red River; the product was gold-silver concentrates, sold to the El Paso smelter. The Taos Mining & Milling Co. shipped 13 tons of gold-silver ore to smelters in 1938. A little placer gold was recovered by sluicing at a placer in Box Canyon near Red River.

The Molybdenum Corporation of America continued production of molybdenum ore from the Phyllis group on Sulphur Creek. The ore is treated in the company 40-ton (per 24 hours) flotation mill at the junction of Sulphur Creek and Red River above Questa.

### TORRANCE COUNTY

A car of copper-gold-silver ore, presumably from a prospect in the Manzano Range near Abo Pass, was shipped from Scholle to the El Paso smelter in 1938.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By CHARLES WHITE MERRILL AND H. M. GAYLORD

## SUMMARY OUTLINE


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The total value of the gold, silver, copper, and lead produced in Oregon during 1938—$2,935,053—exceeded that in every year, except 1916, since the mining industry was begun in 1852. The total in 1938 was divided as follows: Gold, over 97 percent; silver, over 2 percent; and copper and lead combined, less than 1 percent. No output of zinc was reported for the year. Baker County continued to be the leading metal producer and contributed 46 percent of the State total value; Grant County accounted for 28 percent, Josephine County 16 percent, and Jackson County 9 percent; and the other 10 producing counties made up the remaining 1 percent.

An outstanding feature of the metal-mining industry in Oregon in 1938 was the great expansion in production at the Cornucopia mine, Cornucopia district, Baker County. This mine, the largest lode producer in the State in 1937, increased its gold output 250 percent. The aggregate production from lode mines other than the Cornucopia was considerably less than in 1937.

Another important feature in the State's mining industry during 1938 was the greatly increased yardage of gravel handled by dredges, of both the connected-bucket and dragline types. Operations included 5 connected-bucket and 11 dragline dredges in 1938 compared with 4 of each type in 1937. Production by other placer methods continued to be relatively small.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.



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*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers. [4] $0.64646464.

*Mine production of gold, silver, copper, lead, and zinc in Oregon, 1934–38, and total, 1852–1938, in terms of recovered metals*

| Year | Mines producing [1] | | Ore, old tailings, etc. (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 95 | 332 | 62,145 | 33,711.59 | $1,178,220 | 46,560 | $30,099 |
| 1935 | 115 | 268 | 184,543 | 54,160.11 | 1,895,604 | 110,385 | 79,339 |
| 1936 | 93 | 166 | 136,338 | 60,753.00 | 2,126,355 | 85,061 | 65,880 |
| 1937 | 104 | 150 | 77,230 | 52,662.00 | 1,843,170 | 60,564 | 46,846 |
| 1938 | 84 | 157 | 74,936 | 81,729.00 | 2,860,515 | 100,507 | 64,974 |
| 1852–1938 | ---------- | ---------- | [2] | 5,317,449.00 | 114,073,758 | 4,489,124 | 4,273,659 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 38,373 | $3,070 | 41,603 | $1,539 | 73,184 | $3,147 | $1,216,075 |
| 1935 | 397,800 | 33,017 | 59,575 | 2,383 | ---------- | ---------- | 2,010,343 |
| 1936 | 574,000 | 52,808 | 158,000 | 7,268 | 122,000 | 6,100 | 2,258,411 |
| 1937 | 820,000 | 99,220 | 218,000 | 12,862 | 48,000 | 3,120 | 2,005,218 |
| 1938 | 76,000 | 7,448 | 46,000 | 2,116 | ---------- | ---------- | 2,935,053 |
| 1852–1938 | [3] 12,004 | 4,561,269 | [3] 605 | 60,215 | [3] 140 | 13,846 | 122,982,747 |

[1] Beginning with 1936, excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property. [2] Figures not available. [3] Short tons.

*Gold produced at placer mines in Oregon, 1934–38, by classes of mines and by methods of recovery*

| Class and method | Mines producing [1] | Material treated (cubic yards) | Gold recovered | | |
|---|---|---|---|---|---|
| | | | Fine ounces | Value | Average per cubic yard |
| Surface placers: | | | | | |
| Gravel mechanically handled: | | | | | |
| Connected-bucket dredges: | | | | | |
| 1934 | 4 | 1,912,000 | 9,254.47 | $323,444 | $0.169 |
| 1935 | 5 | 3,440,000 | 12,720.13 | 445,205 | .129 |
| 1936 | 5 | 5,148,000 | 17,067.26 | 597,354 | .116 |
| 1937 | 4 | 5,017,000 | 17,178.00 | 601,230 | .120 |
| 1938 | 5 | 7,258,226 | 29,006.00 | 1,015,210 | .140 |
| Dragline dredges: [2] | | | | | |
| 1934 | ---------- | ---------- | ---------- | ---------- | ---------- |
| 1935 | 3 | 1,237,000 | 4,008.23 | 140,288 | .113 |
| 1936 | 4 | 2,066,000 | 12,989.42 | 454,630 | .220 |
| 1937 | 4 | 2,085,000 | 9,126.00 | 319,410 | .153 |
| 1938 | 11 | 2,890,588 | 15,939.00 | 557,865 | .193 |

[1] Beginning with 1936, excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Includes all placer operations using dragline type of power shovel for excavating and delivering gravel to floating washing plant.

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*Gold produced at placer mines in Oregon, 1934–38, by classes of mines and by methods of recovery*—Continued

| Class and method | Mines producing | Material treated (cubic yards) | Gold recovered | | |
|---|---|---|---|---|---|
| | | | Fine ounces | Value | Average per cubic yard |
| Surface placers—Continued. | | | | | |
| Gravel mechanically handled—Contd. | | | | | |
| Nonfloating washing plants: [3] | | | | | |
| 1934 | 5 | 163,000 | 1,031.47 | $36,050 | $0.221 |
| 1935 | 11 | 327,000 | 5,040.89 | 176,431 | .540 |
| 1936 | 6 | 136,000 | 1,479.21 | 51,772 | .381 |
| 1937 | 9 | 186,000 | 2,017.00 | 70,595 | .380 |
| 1938 | 5 | 136,373 | 1,768.00 | 61,880 | .454 |
| Gravel hydraulically handled: | | | | | |
| Hydraulic: | | | | | |
| 1934 | 37 | 513,000 | 2,214.98 | 77,413 | .151 |
| 1935 | 72 | 669,000 | 4,224.84 | 147,869 | .221 |
| 1936 | 52 | 1,051,000 | 2,677.05 | 93,697 | .089 |
| 1937 | 48 | 366,000 | 2,344.00 | 82,040 | .224 |
| 1938 | 66 | 730,830 | 3,261.00 | 114,135 | .156 |
| Small-scale hand methods: [4] | | | | | |
| Wet: | | | | | |
| 1934 | 278 | 754,032 | 8,700.26 | 304,074 | .403 |
| 1935 | 151 | 615,663 | 6,293.52 | 220,273 | .358 |
| 1936 | 79 | 455,580 | 4,785.85 | 167,505 | .368 |
| 1937 | 71 | 173,892 | 3,197.00 | 111,895 | .643 |
| 1938 | 57 | 332,703 | 3,874.00 | 135,590 | .408 |
| Dry: [5] | | | | | |
| 1938 | 2 | 800 | 16.00 | 560 | .700 |
| Underground placers: | | | | | |
| Drift: | | | | | |
| 1934 | 8 | 2,968 | 1,038.73 | 36,304 | 12.232 |
| 1935 | 26 | 7,337 | 416.42 | 14,575 | 1.987 |
| 1936 | 20 | 5,420 | 422.21 | 14,777 | 2.726 |
| 1937 | 15 | 3,108 | 357.00 | 12,495 | 4.020 |
| 1938 | 11 | 5,371 | 467.00 | 16,345 | 3.043 |
| Grand total placer: | | | | | |
| 1934 | 332 | 3,345,000 | 22,239.91 | 777,285 | .232 |
| 1935 | 268 | 6,296,000 | 32,704.03 | 1,144,641 | .182 |
| 1936 | 166 | 8,862,000 | 39,421.00 | 1,379,735 | .156 |
| 1937 | [6] 150 | 7,831,000 | 34,219.00 | 1,197,665 | .153 |
| 1938 | 157 | 11,354,891 | 54,331.00 | 1,901,585 | .167 |

[3] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[4] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.
[5] None reported for 1934–37, inclusive.
[6] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

*Gold.*—Production of gold in Oregon in 1938 increased 55 percent over 1937; the output from placer mines increased 59 percent and that from lode mines 49 percent. Although 241 properties produced in 1938, the bulk of the gold came from relatively few mines; 13 properties produced 80 percent of the total. Of the placer gold, 54 percent was recovered by dredges of the connected-bucket type, 29 percent by dragline dredges, 7 percent by small-scale hand methods, 6 percent by hydraulicking, and the remaining 4 percent by nonfloating washing plants with mechanical excavators and by drift mines. Virtually all the lode gold was derived from dry and siliceous gold ores or from old siliceous tailings. Smelting of concentrates from concentrating and amalgamating mills recovered 72 percent of the lode gold; amalgamation, cyanidation, and direct smelting of ore recovered the remainder. Of the 10 leading gold producers of the State those ranking first, ninth, and tenth were lode mines, and

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the rest were dredging operations; the operations ranking fourth and sixth employed dragline dredges and the others connected-bucket dredges.

*Silver.*—Silver production in Oregon in 1938 increased 66 percent in quantity and 39 percent in value over 1937. Baker County yielded 87 percent and Grant County 10 percent of the State total; dry and siliceous gold ore yielded 87 percent and placer gravels 8 percent; and concentration followed by smelting of the resulting concentrates recovered 85 percent of the total. Almost three-fourths of the silver produced in Oregon in 1938 from both lode and placer properties came from the Cornucopia mine, Cornucopia district, Baker County.

*Copper, lead, and zinc.*—Since cessation of operations by the Balm Creek Gold Mining Co. in Baker County and closing of the Silver Peak mine in Douglas County, production of copper in Oregon has been negligible. Likewise, quiescence of the Bohemia district in Lane County eliminated production of zinc in Oregon and had nearly the same effect on the lead output of the State.

## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Oregon in 1938, by counties, in terms of recovered metals*

| County | Mines producing [1] | | Gold | | | | | | Silver (lode and placer) [2] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lode | | Placer | | Total | | | |
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value | Fine ounces | Value | Fine ounces | Value |
| Baker | 23 | 29 | 22,478 | $786,730 | 14,301 | $500,535 | 36,779 | $1,287,265 | 86,997 | $56,240 |
| Coos | | 5 | | | 114 | 3,990 | 114 | 3,990 | 18 | 12 |
| Curry | 2 | 6 | 101 | 3,535 | 85 | 2,975 | 186 | 6,510 | 14 | 9 |
| Douglas | 2 | 8 | 36 | 1,260 | 326 | 11,410 | 362 | 12,670 | 40 | 26 |
| Grant | 19 | 28 | 1,146 | 40,110 | 22,501 | 787,535 | 23,647 | 827,645 | 9,934 | 6,422 |
| Harney | 1 | 1 | 2 | 70 | 10 | 350 | 12 | 420 | 2 | 1 |
| Jackson | 21 | 25 | 940 | 32,900 | 6,434 | 225,190 | 7,374 | 258,090 | 1,678 | 1,085 |
| Josephine | 11 | 49 | 2,671 | 93,485 | 10,371 | 362,985 | 13,042 | 456,470 | 1,774 | 1,147 |
| Lane | 3 | | 15 | 525 | | | 15 | 525 | 9 | 6 |
| Malheur | | 3 | | | 146 | 5,110 | 146 | 5,110 | 27 | 17 |
| Marion | 2 | (3) | 9 | 315 | 2 | 70 | 11 | 385 | 9 | 6 |
| Morrow | | 1 | | | 1 | 35 | 1 | 35 | | |
| Union | | 1 | | | 11 | 385 | 11 | 385 | | |
| Wheeler | | 1 | | | 29 | 1,015 | 29 | 1,015 | 5 | 3 |
| Total, 1938 | 84 | 157 | 27,398 | 958,930 | 54,331 | 1,901,585 | 81,729 | 2,860,515 | 100,507 | 64,974 |
| Total, 1937 | 104 | 150 | 18,443 | 645,505 | 34,219 | 1,197,665 | 52,662 | 1,843,170 | 60,564 | 46,846 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Baker | 74,000 | $7,252 | 42,000 | $1,932 | | | $1,352,689 |
| Coos | | | | | | | 4,002 |
| Curry | | | | | | | 6,519 |
| Douglas | | | | | | | 12,696 |
| Grant | 2,000 | 196 | 2,000 | 92 | | | 834,355 |
| Harney | | | | | | | 421 |
| Jackson | | | 2,000 | 92 | | | 259,267 |
| Josephine | | | | | | | 457,617 |
| Lane | | | | | | | 531 |
| Malheur | | | | | | | 5,127 |
| Marion | | | | | | | 391 |
| Morrow | | | | | | | 35 |
| Union | | | | | | | 385 |
| Wheeler | | | | | | | 1,018 |
| Total, 1938 | 76,000 | 7,448 | 46,000 | 2,116 | | | 2,935,053 |
| Total, 1937 | 820,000 | 99,220 | 218,000 | 12,862 | 48,000 | $3,120 | 2,005,218 |

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[2] Source of total silver, as follows: 1938, 92,206 ounces from lode mines and 8,301 ounces from placers; 1937, 55,540 ounces from lode mines and 5,024 ounces from placers.

[3] Not reported.

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## MINING INDUSTRY

Of the 61,278 tons of ore sold or treated in Oregon during 1938, all but 364 tons was dry and siliceous gold ore; the 13,658 tons of old tailings treated contained no substantial values other than gold. Thus, the great importance to Oregon of gold priced at $35 an ounce is apparent. The increase in Oregon gold production during the last decade has come from relatively few properties. Of the lode gold in 1938, more than two-thirds came from a single property—the Cornucopia mine, Cornucopia district, Baker County. Of the placer gold, two-thirds was recovered by the following five operators: The Sumpter Valley Dredging Co. (connected-bucket dredge), Sumpter district, Baker County; Western Dredging Co. (connected-bucket dredge), Canyon district, Grant County; Ferris & Marchbank (dragline dredge), Canyon district, Grant County; Rogue River Gold Co. (connected-bucket dredge), Greenback district, Josephine County; and B-H Co. (dragline dredge), Upper Applegate district, Jackson County. The foregoing six properties contributed two-thirds of the total value of the State output of gold, silver, copper, and lead in 1938.

### ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore and old tailings sold or treated in Oregon in 1938, with content in terms of recovered metals*

| Source | Material sold or treated | | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | | | | | |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 60,914 | 13,658 | 27,281 | 87,053 | 73,834 | 44,234 | -------- |
| Dry and siliceous gold-silver ore | 351 | ---------- | 89 | 4,903 | 1,506 | 1,468 | -------- |
| Dry and siliceous silver ore | 2 | ---------- | ---------- | 200 | ---------- | ---------- | -------- |
| | 61,267 | 13,658 | 27,370 | 92,156 | 75,340 | 45,702 | -------- |
| Copper ore | 9 | ---------- | 10 | 4 | 660 | ---------- | -------- |
| Lead ore | 2 | ---------- | 18 | 46 | ---------- | 298 | -------- |
| Total, lode mines | 61,278 | 13,658 | 27,398 | 92,206 | 76,000 | 46,000 | -------- |
| Total, placers | ---------- | ---------- | 54,331 | 8,301 | ---------- | ---------- | -------- |
| | 61,278 | 13,658 | 81,729 | 100,507 | 76,000 | 46,000 | -------- |
| Total, 1937 | 70,923 | 6,307 | 52,662 | 60,564 | 820,000 | 218,000 | 48,000 |

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*Dry and siliceous gold ore and old tailings sold or treated in Oregon in 1938, by counties, with content in terms of recovered metals*

| County | Material sold or treated | | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | | | | | |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Baker | 46,882 | 4,448 | 22,468 | 83,746 | 73,340 | 42,000 | ---- |
| Curry | 152 | ---- | 101 | 6 | ---- | ---- | ---- |
| Douglas | 26 | ---- | 36 | 7 | ---- | ---- | ---- |
| Grant | 2,573 | ---- | 1,057 | 1,987 | 494 | 532 | ---- |
| Harney | 9 | ---- | 2 | ---- | ---- | ---- | ---- |
| Jackson | 2,485 | 100 | 922 | 641 | ---- | 1,702 | ---- |
| Josephine | 8,676 | 8,800 | 2,671 | 648 | ---- | ---- | ---- |
| Lane | 5 | 310 | 15 | 9 | ---- | ---- | ---- |
| Marion | 106 | ---- | 9 | 9 | ---- | ---- | ---- |
| | 60,914 | 13,658 | 27,281 | 87,053 | 73,834 | 44,234 | ---- |
| Total, 1937 | 68,093 | 6,307 | 17,429 | 49,272 | 533,300 | 212,600 | 48,000 |

## METALLURGIC INDUSTRY

Of the 74,936 tons of ore (including 13,658 tons of old tailings) sold or treated in 1938 in Oregon, 51,339 tons (including 4,448 tons of old tailings) were produced in Baker County; Josephine County produced 17,476 tons, of which 8,800 tons were old tailings. Of the total, 61 percent was treated in concentrating mills, most of which used flotation; 37 percent was treated in amalgamation and cyanidation mills, with or without concentration equipment; and the remainder was shipped crude for smelting. Seventy-two percent of the lode gold was recovered ultimately by the smelting of concentrates; 11 percent as bullion by amalgamation of ore and old tailings; 10 percent by cyanidation of ore, concentrates, and old tailings; and 7 percent by direct smelting of ore. All material requiring smelting was shipped out of the State, as Oregon has no smelters.

*Mine production of metals in Oregon in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore and old tailings amalgamated | 6,461 | 2,952 | 608 | ---- | ---- | ---- |
| Ore, concentrates, and old tailings cyanided | 21,193 | 2,611 | 592 | ---- | ---- | ---- |
| Concentrates smelted: | | | | | | |
| Flotation | 1,979 | 19,522 | 85,026 | 72,604 | 44,267 | ---- |
| Gravity | 55 | 250 | 289 | 716 | 328 | ---- |
| Ore smelted | 1,420 | 2,063 | 5,691 | 2,680 | 1,405 | ---- |
| Total, lode mines | ---- | 27,398 | 92,206 | 76,000 | 46,000 | ---- |
| Total, placers | ---- | 54,331 | 8,301 | ---- | ---- | ---- |
| Total, 1937 | ---- | 81,729 | 100,507 | 76,000 | 46,000 | ---- |
| | ---- | 52,662 | 60,564 | 820,000 | 218,000 | 48,000 |

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*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1938, by types of mills and by counties, in terms of recovered metals*

AMALGAMATION MILLS

| County | Material treated | | Recovered in bullion | | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ore [1] | Old tailings | Gold | Silver | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Baker | 2,278 | | 1,588 | 255 | 7 | 17 | 14 | 716 | | |
| Curry | 152 | | 101 | 6 | | | | | | |
| Douglas | 26 | | 36 | 7 | | | | | | |
| Grant | 868 | | 301 | 78 | 3 | 2 | 17 | | | |
| Harney | 9 | | 2 | | | | | | | |
| Jackson | 2,083 | | 689 | 207 | 29 | 167 | 215 | | | |
| Josephine | 579 | 50 | 218 | 43 | 4 | 31 | 12 | | | |
| Lane | | 310 | 8 | 3 | | | | | | |
| Marion | 106 | | 9 | 9 | | | | | | |
| | 6,101 | 360 | 2,952 | 608 | 43 | 217 | 258 | 716 | | |
| Total, 1937 | 11,583 | 7 | 2,231 | 735 | 462 | 1,067 | 3,449 | 19,000 | 145,600 | 48,000 |

CYANIDATION MILLS

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Baker | 146 | 3,100 | 236 | 36 | | | | | | |
| Grant | 1,030 | | 204 | 43 | | | | | | |
| Jackson | | 100 | 13 | 9 | | | | | | |
| Josephine | 8,067 | 8,750 | 2,158 | 504 | | | | | | |
| | 9,243 | 11,950 | 2,611 | 592 | | | | | | |
| Total, 1937 | 3,187 | 3,800 | 761 | 224 | | | | | | |
| Grand total: 1938 | 15,344 | 12,310 | 5,563 | 1,200 | 43 | 217 | 258 | 716 | | |
| 1937 | 14,770 | 3,807 | 2,992 | 959 | 462 | 1,067 | 3,449 | 19,000 | 145,600 | 48,000 |

[1] Ore figures, include concentrates cyanided.

*Mine production of metals from concentrating mills in Oregon in 1938, by counties, in terms of recovered metals*

| County | Material treated | | Concentrates smelted and recovered metal | | | | |
|---|---|---|---|---|---|---|---|
| | Ore | Old tailings | Concentrates produced | Gold | Silver | Copper | Lead |
| | *Short tons* | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Baker | 44,010 | 1,348 | 1,955 | 19,441 | 82,729 | 72,449 | 41,425 |
| Grant | 250 | | 26 | 63 | 2,123 | 155 | 1,468 |
| Jackson | 400 | | 10 | 51 | 205 | | 1,702 |
| | 44,660 | 1,348 | 1,991 | 19,555 | 85,057 | 72,604 | 44,595 |
| Total, 1937 | 52,691 | 2,500 | 5,184 | 12,363 | 42,765 | 513,300 | 66,300 |

*Gross metal content of concentrates produced from ores mined in Oregon in 1938, by classes of concentrates*

| Class of concentrates | Concentrates | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 2,001 | 19,692 | 83,178 | 74,190 | 68,343 | |
| Dry gold-silver | 26 | 63 | 2,123 | 238 | 1,530 | |
| Copper | 7 | 17 | 14 | 738 | | |
| | 2,034 | 19,772 | 85,315 | 75,166 | 69,873 | |
| Total, 1937 | 5,646 | 13,430 | 46,214 | 560,718 | 240,670 | 67,973 |

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*Mine production of metals from Oregon concentrates shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Baker | 1,962 | 19,458 | 82,743 | 73,165 | 41,425 | ---------- |
| Grant | 29 | 65 | 2,140 | 155 | 1,468 | ---------- |
| Jackson | 39 | 218 | 420 | ---------- | 1,702 | ---------- |
| Josephine | 4 | 31 | 12 | ---------- | ---------- | ---------- |
| | 2,034 | 19,772 | 85,315 | 73,320 | 44,595 | ---------- |
| Total, 1937 | 5,646 | 13,430 | 46,214 | 532,300 | 211,900 | 48,000 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 2,001 | 19,692 | 83,178 | 72,449 | 43,127 | ---------- |
| Dry gold-silver | 26 | 63 | 2,123 | 155 | 1,468 | ---------- |
| Copper | 7 | 17 | 14 | 716 | ---------- | ---------- |
| | 2,034 | 19,772 | 85,315 | 73,320 | 44,595 | ---------- |

*Gross metal content of Oregon crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | Gross metal content | | | |
|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 1,306 | 2,009 | 2,661 | 1,221 | 1,663 |
| Dry and siliceous gold-silver | 101 | 26 | 2,780 | 1,363 | ---------- |
| Dry and siliceous silver | 2 | ---------- | 200 | 54 | 20 |
| Copper | 9 | 10 | 4 | 826 | ---------- |
| Lead | 2 | 18 | 46 | ---------- | 314 |
| | 1,420 | 2,063 | 5,691 | 3,464 | 1,997 |
| Total, 1937 | 3,462 | 2,021 | 8,367 | 297,592 | 8,001 |

*Mine production of metals from Oregon crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead |
|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Baker | 603 | 1,196 | 716 | 335 | 575 |
| Grant | 778 | 576 | 4,829 | 1,845 | 532 |
| Jackson | 4 | 20 | 51 | ---------- | 298 |
| Josephine | 30 | 264 | 89 | ---------- | ---------- |
| Lane | 5 | 7 | 6 | ---------- | ---------- |
| | 1,420 | 2,063 | 5,691 | 2,680 | 1,405 |
| Total, 1937 | 3,462 | 2,021 | 8,367 | 297,700 | 6,100 |

BY CLASSES OF ORE

| | | | | | |
|---|---|---|---|---|---|
| Dry and siliceous gold | 1,306 | 2,009 | 2,661 | 669 | 1,107 |
| Dry and siliceous gold-silver | 101 | 26 | 2,780 | 1,351 | ---------- |
| Dry and siliceous silver | 2 | ---------- | 200 | ---------- | ---------- |
| Copper | 9 | 10 | 4 | 660 | ---------- |
| Lead | 2 | 18 | 46 | ---------- | 298 |
| | 1,420 | 2,063 | 5,691 | 2,680 | 1,405 |

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## REVIEW OF COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, and lead in Oregon in 1938, by counties and districts, in terms of recovered metals*

| County and district [1] | Mines producing [2] | | Ore and old tailings | Gold | | | Silver (lode and placer) [3] | Copper | Lead | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | |
| Baker County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | |
| Baker | | 5 | | | 541 | 541 | 76 | | | $18,984 |
| Bull Run | 2 | | 138 | 66 | | 66 | 22 | 716 | | 2,394 |
| Connor Creek | | 1 | | | 105 | 105 | 16 | | | 3,685 |
| Cornucopia | 4 | 4 | 43,723 | 18,688 | 165 | 18,853 | 74,039 | 68,731 | 16,914 | 715,232 |
| Cracker Creek | 1 | | 87 | 117 | | 117 | 23 | | | 4,110 |
| Eagle Creek | | (4) | | | 4 | 4 | | | | 140 |
| Hereford | | 6 | | | 575 | 575 | 109 | | | 20,195 |
| Homestead | | (4) | | | 3 | 3 | 2 | | | 106 |
| Mormon Basin [5] | 3 | 6 | 137 | 54 | 310 | 364 | 73 | | | 12,787 |
| Rock Creek | 3 | (4) | 1,730 | 1,034 | 17 | 1,051 | 9,247 | 4,553 | 24,976 | 44,358 |
| Sparta | 2 | 2 | 1,767 | 1,334 | 19 | 1,353 | 214 | | | 47,493 |
| Sumpter | | 4 | | | 12,423 | 12,423 | 2,917 | | | 436,691 |
| Virtue | 4 | (4) | 3,643 | 995 | 8 | 1,003 | 179 | | 110 | 35,226 |
| Weatherby | 4 | (4) | 114 | 190 | 111 | 301 | 77 | | | 10,585 |
| Coos County: | | | | | | | | | | |
| Coos Bay | | (4) | | | 2 | 2 | 1 | | | 71 |
| Johnson Creek | | 3 | | | 87 | 87 | 14 | | | 3,054 |
| Randolph | | 1 | | | 18 | 18 | 2 | | | 631 |
| Curry County: | | | | | | | | | | |
| Agness | | (4) | | | 4 | 4 | | | | 140 |
| Chetco | 1 | | 150 | 98 | | 98 | 5 | | | 3,433 |
| China Diggings | 1 | | 2 | 3 | | 3 | 1 | | | 106 |
| Gold Beach | | 1 | | | 24 | 24 | 1 | | | 841 |
| Mule Creek | | 1 | | | 3 | 3 | | | | 105 |
| Port Orford | | 2 | | | 43 | 43 | 3 | | | 1,507 |
| Sixes | | 2 | | | 11 | 11 | 4 | | | 387 |
| Douglas County: | | | | | | | | | | |
| Cow Creek | | 3 | | | 173 | 173 | 17 | | | 6,066 |
| Green Mountain | 2 | (4) | 26 | 36 | 31 | 67 | 9 | | | 2,351 |
| Myrtle Creek | | 3 | | | 63 | 63 | 9 | | | 2,211 |
| Riddle | | (4) | | | 8 | 8 | 2 | | | 281 |

See footnotes at end of table.

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*Mine production of gold, silver, copper, and lead in Oregon in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore and old tailings | Gold | | | Silver (lode and placer) | Copper | Lead | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | |
| Grant County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | |
| Black Butte | 1 | | 20 | 3 | | 3 | 1 | | | $106 |
| Canyon | 3 | 10 | 432 | 98 | 15,829 | 15,927 | 1,708 | | | 558,549 |
| Desolation | | 2 | | | 23 | 23 | 4 | | | 808 |
| Granite | 5 | 3 | 1,924 | 780 | 2,122 | 2,902 | 3,943 | 649 | 1,773 | 104,264 |
| Greenhorn [6] | 7 | 5 | 467 | 176 | 848 | 1,024 | 3,672 | 1,351 | 227 | 38,357 |
| North Fork John Day | | 4 | | | 15 | 15 | 3 | | | 527 |
| Quartzburg | 2 | 2 | 81 | 70 | 604 | 674 | 120 | | | 23,668 |
| Susanville | 1 | (7) | 2 | 19 | (7) | [8] 19 | [8] 3 | | | [8] 667 |
| Harney County: | | | | | | | | | | |
| Idol City | | 1 | | | 10 | 10 | 2 | | | 351 |
| Pueblo Mountain | 1 | | 9 | 2 | | 2 | | | | 70 |
| Jackson County: | | | | | | | | | | |
| Ashland | 1 | 1 | 1,815 | 663 | 50 | 713 | 250 | | | 25,117 |
| Gold Hill | 8 | 7 | 155 | 74 | 351 | 425 | 81 | | | 14,927 |
| Greenback [9] | 1 | (4) | 20 | 4 | 30 | 34 | 5 | | | 1,193 |
| Jacksonville | 4 | 2 | 183 | 116 | 221 | 337 | 213 | | | 11,933 |
| Upper Applegate | 5 | 15 | 11 | 12 | 5,782 | 5,794 | 877 | | | 203,357 |
| Josephine County: | | | | | | | | | | |
| Althouse | | (4) | | | 43 | 43 | 6 | | | 1,509 |
| Galice | (7) | 11 | (7) | (7) | 591 | [10] 591 | [10] 64 | | | [10] 20,726 |
| Grants Pass | 1 | 2 | 343 | 83 | 564 | 647 | 86 | | | 22,701 |
| Greenback [9] | 2 | 13 | 8,750 | 353 | 6,687 | 7,040 | 1,071 | | | 247,092 |
| Illinois River | 2 | 8 | 16 | 12 | 383 | 395 | 47 | | | 13,855 |
| Lower Applegate | 3 | 3 | 238 | 370 | 178 | 548 | 147 | | | 19,275 |
| Waldo | 1 | 12 | 12 | 2 | 1,925 | 1,927 | 211 | | | 67,581 |
| Lane County: Bohemia | 3 | | 315 | 15 | | 15 | 9 | | | 531 |
| Malheur County: | | | | | | | | | | |
| Malheur | | 1 | | | 19 | 19 | 3 | | | 667 |
| Mormon Basin [5] | | 2 | | | 114 | 114 | 22 | | | 4,004 |
| Snake River | | (4) | | | 13 | 13 | 2 | | | 456 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Marion County: North Santiam | 1 | (4) | 6 | 1 | 2 | 3 | 1 | ---------- | ---------- | 106 |
| Morrow County: Columbia River | ---------- | 1 | ---------- | ---------- | 1 | 1 | ---------- | ---------- | ---------- | 35 |
| Union County: Camp Carson | ---------- | 1 | ---------- | ---------- | 11 | 11 | ---------- | ---------- | ---------- | 385 |
| Wheeler County: Spanish Gulch | ---------- | 1 | ---------- | ---------- | 29 | 29 | 5 | ---------- | ---------- | 1,018 |
| Combined districts [11] | 5 | 6 | 8,620 | 1,930 | 3,138 | 5,068 | 889 | ---------- | 2,000 | 178,048 |
| Total Oregon | 84 | 157 | 74,936 | 27,398 | 54,331 | 81,729 | 100,507 | 76,000 | 46,000 | 2,935,053 |

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 11 and their output included under "Combined districts."

[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[3] Source of total silver as follows: 92,206 ounces from lode mines and 8,301 ounces from placers.

[4] Not reported.

[5] Mormon Basin district lies in both Baker and Malheur Counties.

[6] Greenhorn district lies in both Baker and Grant Counties.

[7] Included under "Combined districts."

[8] Exclusive of placer output, which is included under "Combined districts."

[9] Greenback district lies in both Jackson and Josephine Counties.

[10] Exclusive of lode output, which is included under "Combined districts."

[11] Includes following districts: Greenhorn (placer) in Baker County; Rock Creek (placer) in Coos County; Canyonville (placer) and Mount Reuben (placer) in Douglas County; Susanville (placer) in Grant County; Elk Creek (lode) in Jackson County; Galice (lode) in Josephine County; and Gold Butte (lode) in Marion County.

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### BAKER COUNTY

*Baker district.*—The dragline dredge working on the Elk Creek Placers was the principal producer in the Baker district in 1938; litigation closed operations in September.

*Cornucopia district.*—The Cornucopia mine, operated by Cornucopia Gold Mines, treated 42,310 tons of gold ore and 1,348 tons of old tailings by flotation during 1938 and became the largest gold producer in Oregon after a record of several years as the largest producing lode mine. The metals recovered from 1,590 tons of concentrates and 8 tons of crude ore shipped to a smelter were: Gold, 18,604 fine ounces; silver, 73,824 fine ounces; copper, 68,071 pounds; and lead, 16,494 pounds.

*Hereford district.*—L. B. Jackson and W. B. Pattison operated during the last 8 months of 1938 a nonfloating washing plant, fed by power shovel, on their property 6 miles east of Hereford.

*Rock Creek district.*—Operations at the Highland Maxwell mine were terminated during 1938.

*Sparta district.*—The Maiden Creek mine, formerly known as the Macy, produced 1,764 tons of gold ore yielding 1,331 ounces of gold and 207 ounces of silver in 1938; it was the largest producer in the Sparta district.

*Sumpter district.*—The Sumpter Valley Dredging Co. operated a connected-bucket dredge, equipped with seventy-two 9-cubic-foot buckets, at its Sumpter Valley Placers throughout 1938 and was the largest producer of placer gold in the State. Consuelo Oregon Mines started production with a dragline dredge in May 1938. H. F. England & Co. operated a dragline dredge in the Sumpter district for 30 days but owing to unsatisfactory recoveries moved to a property near Prairie City in the Quartzburg district, Grant County. Little, Harris, and Wolfinger mined 100,000 cubic yards of gravel with a dragline dredge equipped with a 1½-cubic-yard bucket and produced 714 ounces of gold between October 8 and the end of 1938.

*Virtue district.*—The Hidden Treasure mine was the only large producer in the Virtue district in 1938; 351 tons of ore shipped for smelting yielded 641 ounces of gold and 130 ounces of silver.

### COOS COUNTY

*Johnson Creek district.*—Several small-scale placer operations in 1938 were reported along Johnson Creek.

### CURRY COUNTY

*Port Orford district.*—Dorothy Faris and Associates, the largest producer in Curry County in 1938, suspended operations at the Cape Blanco placer when its lease expired March 29.

### DOUGLAS COUNTY

*Cow Creek district.*—Several small placer operations in 1938 were reported along Cow Creek, particularly at Yokum Bar.

### GRANT COUNTY

*Canyon district.*—Ferris & Marchbank treated 1,512,595 cubic yards of gravel and recovered 7,707 ounces of gold with a Diesel-powered dragline dredge operating on John Day River west of John Day; the

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equipment consisted also of a Diesel-electric floating washer. The Western Dredging Co. operated a connected-bucket dredge, equipped with seventy-two 6-cubic-foot buckets, throughout 1938. The Miller Mountain mine was the most-productive lode property in the Canyon district.

*Granite district.*—Porter & Co. began operations September 10, 1938, in the Granite district with a connected-bucket dredge, equipped with sixty-two 4½-cubic-foot buckets; the property, owned by the Blue Mountain Gold Dredging Co., is near Granite and adjoins Granite, Olive, Clear, Crane, and Bull Run Creeks. Independence Cougar Mines, which operated the Independence and Cougar groups, shipped 621 tons of ore from which 501 ounces of gold were recovered. At the New York mine 1,030 tons of ore were treated by cyanidation, with a recovery of 204 ounces of gold.

*Greenhorn district.*—The Western Gold Corporation began dragline dredge operations September 8, 1938, on Granite Creek and was the largest producer of gold in the Greenhorn district in 1938. Ore from the Intermountain mine was shipped for smelting.

*Quartzburg district.*—H. F. England & Co. moved its dragline dredge from the Sumpter district in Baker County to the Quartzburg district and began operations October 18, 1938, on Dixie Creek 1 mile from Prairie City; the treatment of 90,000 cubic yards of gravel yielded 513 ounces of gold. Ore from the Yankee Boy group north of Prairie City was treated by amalgamation.

*Susanville district.*—The Timms Gold Dredging Co. operated its connected-bucket dredge, equipped with sixty-four 3½-cubic-foot buckets, throughout 1938 on the Middle Fork of John Day River; it was the chief producer in the Susanville district.

### JACKSON COUNTY

*Ashland district.*—P. B. Wickham continued development at the Ashland mine during 1938 and obtained considerable gold ore that was treated by amalgamation.

*Gold Hill district.*—A lessee worked the Lance Bros. property on Foots Creek with a nonfloating washing plant from the first of 1938 until April 20; 25,700 cubic yards of material were treated to recover 241 ounces of gold. The Black Channel mine, also on Foots Creek, was operated by hydraulicking during the first 4 months of the year. Several other mines, both lode and placer, reported small outputs.

*Upper Applegate district.*—The B-H Co. worked its placer property on Forest Creek by dragline dredging throughout most of 1938. Christean & Dobbyn worked a drift mine on Forest Creek which yielded more gold than any other drift operation in the State. The Glide Foundation operated a dragline dredge on Poorman's Creek part time over a period of 4 months in 1938. Sterling Mines, Inc., worked its hydraulic mine on Sterling Creek and was the second-largest producer of gold recovered by hydraulicking in the State.

### JOSEPHINE COUNTY

*Galice district.*—A large number of small operators were reported active at placer mines in the Galice district during 1938. Small-scale hand methods yielded considerable gold at the Old Channel

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property. The Lewis Investment Co. worked the Benton mine almost continuously in 1938 and shipped its cyanide precipitates to a smelter; this property, which started operations August 28, 1937, was the second-largest producer of lode gold in Oregon in 1938. A small output of gold ore was reported from the J. C. L. mine during 6 months of operation.

*Grants Pass district.*—Surety Placers, Inc., worked a substantial yardage by hydraulicking at its property on Louse Creek during the early months of 1938; later in the year a lessee started operations. The Lambtongue mine north of Grants Pass produced 343 tons of gold ore, from which 83 ounces of gold were recovered by amalgamation and smelting of concentrates.

*Greenback district.*—The principal producer in the Greenback district—the Rogue River Gold Co.—discontinued operation of its connected-bucket dredge November 30, 1938, after several years of production; the dredge was of the company's own design and construction and was equipped with sixty-five 7½-cubic-foot buckets. The company had perfected a method of water clarification to meet the demands of recreational interests on the lower Rogue River. Gravel was mined at the Blue Channel property on Coyote Creek by hydraulicking in 1938. The Columbia mine was one of the larger producers of gold by hydraulicking in the district and in the State. Hydraulicking at the 3 L's mine on Grave Creek resulted in the recovery of 71 ounces of gold from 11,000 cubic yards of gravel. The recovery of 339 ounces of gold and 321 ounces of silver was reported from the cyanidation of 8,600 tons of old tailings at the Greenback mine. During the year P. B. Wickham, of the Ashland mine in Jackson County, leased this property for a period of 10 years; he had no part in production at the mine in 1938 but did some repair work.

*Illinois River district.*—Small placer and lode operations were reported in the Illinois River district in 1938.

*Lower Applegate district.*—The Oregon Bonanza lode mine was operated throughout 1938; treatment of 187 tons of ore, partly by amalgamation and partly by direct smelting, resulted in the recovery of 349 ounces of gold and 114 ounces of silver.

*Waldo district.*—The recovery of 517 ounces of gold from 100,000 cubic yards of gravel by hydraulicking in 1938 was reported at the Esterly (Llano de Oro) mine; this property was the largest producer of gold recovered by hydraulicking in the State. Several operators worked the Leonard mine on Althouse Creek; virtually all the gold was recovered at a stationary washing plant, to which the gravel was delivered by trucks loaded by power shovels. The Platurica (Plataurica) mine in the O'Brien section of the Waldo district yielded 119 ounces of gold from the hydraulicking of 80,000 cubic yards of gravel during the first 3 months of 1938.

### OTHER COUNTIES

Small outputs in 1938 were reported also from Harney, Lane, Malheur, Marion, Morrow, Union, and Wheeler Counties.

Details of production by counties and districts are given in the preceding table.

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# GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

## SUMMARY OUTLINE


| | Page | | Page |
|---|---|---|---|
| Summary | 449 | Mining and metallurgic industry | 451 |
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| Mine production by counties | 451 | Review by counties | 452 |


Gold production in South Dakota set a new annual record in 1938, totaling 594,847 fine ounces valued at $20,819,645. The increase over 1937 was 13,303 ounces and over 1936, the former record year, 8,494 ounces. As usual, the Homestake mine at Lead, Lawrence County, the largest producer of gold in the United States, yielded the bulk of the gold; three other important producers in Lawrence County and one in Pennington County increased their output. Placer mines, mostly on French Creek, produced all the gold shipped from Custer County in 1938. From 1875 through 1938 these three counties, situated in the Black Hills area in the southwestern part of the State, have produced all the State output of gold, silver, copper, and lead. The silver recovered in South Dakota in 1938 was a byproduct of gold mining. No recoverable copper has been produced in the State since 1918 and no lead since 1935.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price: 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.

Except for a slight drop in 1937 from 1936, gold production in South Dakota has increased annually over the 5-year period ended with 1938. The quantity of silver recovered varied somewhat in proportion to the gold produced in the individual years but also increased for



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the period. The only silver recovered other than as a byproduct of gold mining during the 5 years was 1,519 ounces contained in 30 tons of lead-silver ore shipped to a smelter in 1935.

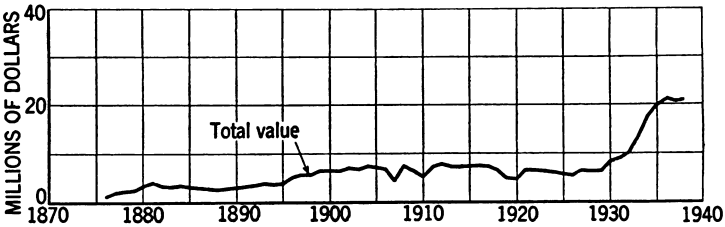


FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876–1938.

*Mine production of gold, silver, copper, and lead in South Dakota, 1934–38, and total, 1875–1938, in terms of recovered metals* [1]

| Year | Mines producing | | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 8 | 258 | 1,520,669 | 486,118.97 | $16,989,858 | 99,741 | $64,479 |
| 1935 | 15 | 199 | 1,487,235 | 567,230.20 | 19,853,057 | 151,047 | 108,565 |
| 1936 | 12 | 130 | 1,549,146 | 586,353.40 | 20,522,369 | 144,448 | 111,875 |
| 1937 | 14 | 73 | 1,597,178 | 581,544.00 | 20,354,040 | 139,638 | 108,010 |
| 1938 | 11 | 71 | 1,586,181 | 594,847.00 | 20,819,645 | 162,295 | 104,918 |
| 1875–1938 | | | [2] | 18,232,108.00 | 419,720,989 | 8,832,407 | 6,288,627 |

| Year | Copper | | Lead | | Total value |
|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | |
| 1934 | | | | | $17,054,337 |
| 1935 | | | 7,000 | $280 | 19,961,902 |
| 1936 | | | | | 20,634,244 |
| 1937 | | | | | 20,462,050 |
| 1938 | | | | | 20,924,563 |
| 1875–1938 | 195,691 | $34,598 | 575,313 | 34,820 | 426,079,034 |

[1] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. I, p. 42; Mineral Resources, 1922, pt. I, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook.
[2] Figures not available.

*Gold and silver produced at placer mines in South Dakota, 1934–38, in terms of recovered metals*

| Year | Gold | | Silver | | Total value |
|---|---|---|---|---|---|
| | Fine ounces | Value | Fine ounces | Value | |
| 1934 | 1,080.20 | $37,753 | 85 | $55 | $37,808 |
| 1935 | 936.86 | 32,790 | 103 | 74 | 32,864 |
| 1936 | 346.80 | 12,138 | 31 | 24 | 12,162 |
| 1937 | 1,010.60 | 35,371 | 75 | 58 | 35,429 |
| 1938 | 1,069.00 | 37,415 | 82 | 53 | 37,468 |

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## MINE PRODUCTION BY COUNTIES

*Mine production of gold and silver in South Dakota in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Gold (lode and placer) | | Silver (lode and placer) | | Total value |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | Fine ounces | Value | Fine ounces | Value | |
| Custer | | 15 | 888.20 | $31,087 | 73 | $47 | $31,134 |
| Lawrence | 6 | 3 | 590,686.60 | 20,674,031 | 161,593 | 104,464 | 20,778,495 |
| Pennington | 5 | 53 | 3,272.20 | 114,527 | 629 | 407 | 114,934 |
| | 11 | 71 | 594,847.00 | 20,819,645 | 162,295 | 104,918 | 20,924,563 |

*Gold and silver produced at placer mines in South Dakota in 1938, by counties and methods of recovery, in fine ounces, in terms of recovered metals*

| County | Sluicing and hydraulic | | Drift mining | | Dry-land dredges [1] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | Gold | Silver | Gold | Silver |
| Custer | 52.80 | 6 | | | 835.40 | 67 | 888.20 | 73 |
| Lawrence | 42.00 | 2 | | | | | 42.00 | 2 |
| Pennington | 82.18 | 5 | 22.47 | 1 | 34.15 | 1 | 138.80 | 7 |
| | 176.98 | 13 | 22.47 | 1 | 869.55 | 68 | 1,069.00 | 82 |
| Total, 1937 | 107.44 | 6 | | | 903.16 | 69 | 1,010.60 | 75 |

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

## MINING AND METALLURGIC INDUSTRY

The total ore mined and treated by producers of lode gold and silver in South Dakota was 1,586,181 tons yielding 593,778 fine ounces of gold and 162,213 fine ounces of silver in 1938 compared with 1,597,178 tons yielding 580,533 ounces of gold and 139,563 ounces of silver in 1937. The average yield in metals per ton of ore therefore increased slightly in 1938. An analysis of methods of treatment shows that 1,417,222 tons were treated by amalgamation followed by cyanidation of sands and slimes; 155,667 tons by cyanidation only or by roasting followed by cyanidation; 1,169 tons by amalgamation only; 12,000 tons by amalgamation and flotation concentration (237 tons of concentrates containing 729.20 ounces of gold and 170 ounces of silver were shipped to smelters); and 123 tons containing 2,091.09 ounces of gold and 664 ounces of silver were shipped crude to smelters. Operating details at both lode and placer mines are given in the following review by counties.

### METALLURGIC RECOVERY

*Gold and silver bullion produced at mills in South Dakota by amalgamation, 1934–38*

| Year | Ore treated | Gold in bullion | Silver in bullion | Quicksilver used |
|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* |
| 1934 | 1,441,052 | 310,941.73 | 58,086 | 9,663 |
| 1935 | 1,382,774 | 335,553.97 | 75,858 | 15,550 |
| 1936 | 1,393,450 | 330,052.08 | 66,585 | 15,093 |
| 1937 | 1,414,772 | 329,975.10 | 66,640 | 10,178 |
| 1938 | 1,430,391 | 328,044.50 | 62,602 | 7,744 |

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*Gold and silver bullion produced at mills in South Dakota by cyanidation, 1934–38*

| Year | Material treated | | | Gold in bullion product | Silver in bullion product | Sodium cyanide used [1] |
|---|---|---|---|---|---|---|
| | Crude ore | Sands and slimes | Total | | | |
| | *Short tons* | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* |
| 1934 | 79,617 | 1,432,045 | 1,511,662 | 174,097.04 | 41,570 | 519,724 |
| 1935 | 104,431 | 1,380,128 | 1,484,559 | 230,653.47 | 73,558 | 686,625 |
| 1936 | 155,652 | 1,382,676 | 1,538,328 | 255,849.83 | 77,811 | 749,923 |
| 1937 | 182,406 | 1,394,252 | 1,576,658 | 249,980.70 | 72,833 | 786,072 |
| 1938 | 155,667 | 1,416,899 | 1,572,566 | 262,913.21 | 98,777 | [2] 860,762 |

[1] In terms of 96- to 98-percent strength.
[2] Actually 1,589,300 pounds of calcium cyanide (48- to 49-percent strength) and 69,745 pounds of sodium cyanide (91-percent strength); all reduced to equivalent of 96- to 98-percent strength to conform with earlier use of figures for high-strength NaCN and KCN.

## REVIEW BY COUNTIES

### CUSTER COUNTY

The Sterling Mining Co. operated its dragline and screening and sluicing plant on French Creek, 1 mile west of Custer, from April 13 to November 15, 1938. The Anchor Gold Mining Co. ran a gasoline shovel and washing plant for 30 days on the McKenna property on French Creek. A dragline and sluice were operated from October 1 to November 1 at the Rhodes property on French Creek, 1 mile east of Custer, and recovered 15.18 fine ounces of gold. Small-scale sluicing and panning along French Creek recovered some gold in 1938. No production was made from lode mines in Custer County during the year.

### LAWRENCE COUNTY

*Homestake mine.*—The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1938, says—

Operations during 1938 were normal in all departments. Ore production from the mine was a little lower than in 1937 and the gross income for gold and silver produced was one-tenth of 1 percent less. Production for 1939 will probably approximate that of 1938.

Operating expenses exclusive of taxes were substantially the same as in 1937. Taxes again increased to a total of $3,052,795.67, or $2.22 per ton of ore mined. The increased tax burden has eliminated a substantial tonnage of marginal ore from the reserve.

There are 189,571 tons of broken ore remaining in shrinkage stopes.

The reserve of developed ore is 18,558,019 tons. Of this reserve 6,446,350 tons are in the new ledge referred to in the report for 1937. The ore developed in this ledge is materially lower in grade than that in the main ledges.

The mine, treatment plants, and other surface plants are in excellent condition. Reconstruction and modernization of Cyanide sand plant No. 1 was completed except for minor alterations of pipes and launders. There was no interruption of operation during construction.

A new operating shaft was authorized in May. It was named the Yates Shaft in memory of Mr. B. C. Yates. This shaft will replace the Ellison Shaft which has for some years been protected by leaving ore pillars. The new shaft will be equipped for an ultimate depth of 5,000 feet. 12,850 feet of connecting drifts for this shaft and 1,576.5 feet of pilot raises in the shaft are completed.

The Ross Shaft is completed to the 4,100-foot level with a 60-foot sump below that level.

The winze from the 4,100-foot level was completed to the 4,400-foot level and 957 feet of level development completed on the 4,400-foot level.

Power output from the hydroelectric plants was slightly less than in 1937. Ample power was supplied from the Kirk power station.

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*Ore milled, receipts, and dividends, Homestake mine, 1934–38* [1]

| Year | Ore milled (short tons) | Receipts for bullion product | | Dividends |
|---|---|---|---|---|
| | | Total | Per ton | |
| 1934 | 1,440,692 | $16,515,684.14 | $11.4637 | $7,534,800 |
| 1935 | 1,379,163 | 19,191,013.19 | 13.9150 | 14,064,960 |
| 1936 | 1,383,929 | 19,506,534.78 | 14.0950 | 9,041,760 |
| 1937 | 1,394,773 | 19,304,076.45 | 13.8403 | 9,041,760 |
| 1938 | 1,377,314 | 19,284,459.67 | 14.0015 | 9,041,760 |

[1] From 1876 to 1938, inclusive, this mine yielded bullion and concentrates that brought a net return of $360,075,014 and paid $115,145,722 in dividends.

The system of mining used at the Homestake mine has been described briefly as follows:[1]

The ore body is first cut by a series of stopes each extending for 60 feet along the strike and from wall to wall of the deposit—a distance which may be as great as 400 feet. Pillars of ore 42 feet in thickness separate the 60-foot stopes. A stope is started by making a cut entirely across its bottom. A timbered gangway provided with chute gates is next constructed across the floor of the cut and waste filling is introduced around it. The stope is then carried upward by shrinkage stoping to within about 25 feet of the level above. The interval between levels is 100 feet in the upper part of the mine and 150 feet in the lower. During shrinkage stoping, the miners stand upon the broken ore, enough being drawn off regularly through the chute gates into the gangway to keep the ore away from the back and provide room for the miners to work. When shrinkage stoping is completed, the broken ore remaining in the stope is all drawn off, and the stope is filled with waste rock or mill tailings. The crowns of the stopes and the pillars between them are later mined by the square-set timbering system, the square sets being filled with waste.

The ore drops from the chutes into ore cars pulled by compressed-air locomotives and is taken to the shafts for hoisting. Primary crushing of the ore is done at the shafts. From the shafts the ore is moved by a rail tramway to the South mill, which has a capacity of 3,900 tons per 24 hours. Here the ore is reduced further by stamps and fed to rod mills in closed circuit with Clark-Todd amalgamators for primary grinding and to ball mills and pebble mills in closed circuit with Clark-Todd amalgamators for secondary grinding. The copper amalgamation plates, for many years an integral part of the mill equipment, gradually are being replaced by the Clark-Todd amalgamators. Classification is done partly in the South mill and is finished in cyanide sand plant No. 1 and cyanide sand plant No. 3. In plant No. 3 part of the sand tailings from the South mill are classified and ground further in ball mills in closed circuit with Clark-Todd amalgamators. The sands are treated by cyanide leaching, and the slimes are thickened and sent to the slime plant at Deadwood for further treatment. In plant No. 1 a partly classified sand portion of the tailings from the South mill is separated by cone classification into sand and slime fractions. In this plant the sands are leached, and the solutions from both this plant and plant No. 3 are precipitated. Slimes are piped to the slime plant at Deadwood, which accomplishes cyanidation of the slimes from both plants. Precipitation is by the Merrill-Crowe process. Silver is parted from the gold in the company refinery, and virtually pure metals are shipped to the mint.

[1] Lincoln, Francis Church, Miser, Walter G., and Cummings, Joseph B., The Mining Industry of South Dakota: South Dakota Sch. Mines Bull. 17, February 1937, pp. 12–14.

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*Other mines.*—The Bald Mountain Mining Co. maintained production from its consolidated group of mines and 325-ton cyanide mill at Trojan continuously at capacity in 1938. The yield in recovered metals from 118,026 tons of ore treated in the mill and 123 tons of high-grade ore shipped to smelters was 23,899 fine ounces of gold and 34,012 fine ounces of silver, which together brought a net return of $851,245.33 after deductions for transportation and mint and smelter charges. The company paid $231,250 in dividends in 1938. Additions to the plant included intermediate grinding and accessory equipment for all ores and a 100-ton rotary hearth roasting furnace for sulfide ores. The ore treated in 1938 came from the Portland, Trojan, Foley, Dakota, and Clinton claims and was brought to the mill by rail tramway and trucks. The company did 13,260 feet of development work in the mine during the year.

Gold production of the Canyon Corporation from the refractory sulfide ores (commonly known as blue ores) of the Maitland group 5½ miles northwest of Deadwood increased in 1938 over 1937. Besides gold and silver, the ores contain pyrite, silica, dolomite, and some undetermined arsenic mineral. Treatment is by the roast-cyanidation process. The mill handled a daily average of 103 tons for 365 days in 1938. Mine development work done totaled 4,850 feet. The mine is opened by a 350-foot shaft and drifts and winzes.

Gilt Edge Mines, Inc., which began production from the Gilt Edge-Dakota Maid group in May 1937, continued operations throughout 1938 at an average rate in excess of 100 tons of ore daily. The mine is opened by a 150-foot vertical shaft and 3,100 feet of useful tunnels and drifts, of which 1,200 feet were driven in 1938. Most of the ore extracted was oxidized, and all was treated by the all-slime cyanide process in the company mill. During the year a jig and amalgam barrel were installed to recover free gold from the ball-mill circuit.

Gold, Inc., continued to do development work at the Minnesota group 4 miles northeast of Rochford on Gimlet Creek and treated ore intermittently in the mill at the mine. The equipment of the mill consists of 10 stamps, jaw crusher, rolls, ball mill, amalgamator, classifier, flotation machine, and table. Small lots of gold recovered by amalgamation were shipped to the Denver Mint. About 30 tons of concentrates produced were stored at the mill. Ore from the Belle Eldridge property was shipped to the Canyon Corporation mill early in 1938.

### PENNINGTON COUNTY

Empire Gold Mines, Inc., operated its Golden Slipper mine 5 miles east of Hill City continuously in 1938. The output was 12,000 tons of ore, which was treated in the company mill by ball-mill grinding, jig concentration, and plate amalgamation, followed by flotation of the tailings from the plates. The jig concentrates were amalgamated in a barrel. Gold valued at $82,388 was recovered by amalgamation and shipped to the Denver Mint during the year. The concentrates, containing gold valued at smelter payment at $23,770, were sold to the East Helena (Mont.) and Leadville (Colo.) smelters. The silver contained in both bullion and concentrates was valued at $350. The ore is hoisted through an incline shaft 550 feet deep. Development work done in the mine during the year totaled 3,500 feet. During December 1938 and January 1939 a cyanide unit was installed to

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treat the flotation concentrates. The other four lode mines and prospects producing in Pennington County in 1938, all operated on a small scale, comprised the Burlington, from which a little gold was recovered by hand methods; Gold Lode, equipped with a 20-ton amalgamation mill; Murphy-Nelson property, equipped with a small jig and table; and Shellerud, equipped with a small stamp-amalgamation mill.

The Anchor Gold Mining Co., working placer ground on Gold Run and Cement Creeks in the summer of 1938 with a 1½-yard dragline excavator and a portable land dredge, handled 5,000 cubic yards of gravel from which were recovered 35.03 crude ounces of placer gold 0.975 fine. Owing to a shortage of water the equipment could not be run continuously, and the total operating time was only about 10 days. Individuals sluicing, drift mining, and panning on Battle, Castle, Rapid, Spring, and Slate Creeks continued to recover small lots of gold dust, most of which was sold to dealers or traded for groceries at stores in the vicinity.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

## SUMMARY OUTLINE


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Virtually all the gold and lead and most of the copper produced in Texas in 1938 came from mines producing silver as the metal of chief value. Compared with 1937, the output of silver in 1938 increased 8 percent in quantity but decreased 10 percent in value owing to a drop of nearly 17 percent in the Government-fixed price of silver. The quantity and value of the other three metals, especially copper, decreased in 1938; however, their combined value was only $105,000 in 1937 and $49,965 in 1938 compared with $1,025,398 and $926,389, respectively, for silver alone. The Presidio mine of the American Metal Co. at Shafter, Presidio County, was the only large producer in the State in 1938. The output of the Plata Verde mine near Van Horn in Hudspeth County, a substantial producer of silver in 1936 and 1937, declined heavily in 1938.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.

## MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1934 to 1938, as well as the total metal production from 1885 to 1938.



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*Mine production of gold, silver, copper, lead, and zinc in Texas, 1934–38, and total, 1885–1938, in terms of recovered metals*

| Year | Ore (short tons) | Gold | | Silver | |
|---|---|---|---|---|---|
| | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 47,680 | 358.74 | $12,538 | 854,442 | $552,367 |
| 1935 | 72,222 | 518.00 | 18,130 | 1,000,960 | 719,440 |
| 1936 | 104,990 | 613.00 | 21,455 | 1,361,459 | 1,054,450 |
| 1937 | 120,145 | 562.00 | 19,670 | 1,325,660 | 1,025,398 |
| 1938 | 131,002 | 439.00 | 15,365 | 1,433,008 | 926,389 |
| 1885-1938 | (1) | 7,099.00 | 182,410 | 28,749,634 | 20,240,960 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 29,000 | $2,320 | 719,000 | $26,603 | ---------- | ---------- | $593,828 |
| 1935 | 28,000 | 2,324 | 1,043,000 | 41,720 | ---------- | ---------- | 781,614 |
| 1936 | 53,000 | 4,876 | 935,000 | 43,010 | ---------- | ---------- | 1,123,791 |
| 1937 | 320,000 | 38,720 | 790,000 | 46,610 | ---------- | ---------- | 1,130,398 |
| 1938 | 32,000 | 3,136 | 684,000 | 31,464 | ---------- | ---------- | 976,354 |
| 1885-1938 | [2] 886 | 262,885 | [2] 3,976 | 400,203 | [2] 744 | $106,491 | 21,192,949 |

[1] Figures not available.
[2] Short tons.

*Mine production of gold, silver, copper, and lead in Texas in 1938, by counties, in terms of recovered metals*

| County | Mines producing | Ore (short tons) | Gold (fine ounces) | Silver (fine ounces) | Copper (pounds) | Lead (pounds) |
|---|---|---|---|---|---|---|
| Culberson | 2 | 378 | ---------- | 8,214 | 7,000 | ---------- |
| Hudspeth | 4 | 3,050 | 0.53 | 45,607 | 25,000 | 3,000 |
| Presidio | 1 | 127,574 | 438.47 | 1,379,187 | ---------- | 681,000 |
| | 7 | 131,002 | 439.00 | 1,433,008 | 32,000 | 684,000 |
| Total, 1937 | 7 | 120,145 | 562.00 | 1,325,660 | 320,000 | 790,000 |

## ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore sold or treated in Texas in 1938, with content in terms of recovered metals*

| Source | Mines producing | Ore | Gold | Silver | Copper | Lead |
|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Dry and siliceous silver ore | 3 | 130,923 | 438.47 | 1,431,696 | 25,674 | 682,560 |
| Copper ore | 3 | 70 | ---------- | 1,235 | 6,326 | ---------- |
| Lead ore | 2 | 9 | .53 | 77 | ---------- | 1,440 |
| | [1] 7 | 131,002 | 439.00 | 1,433,008 | 32,000 | 684,000 |
| Total, 1937 | 7 | 120,145 | 562.00 | 1,325,660 | 320,000 | 790,000 |

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

## SMELTING AND REFINING PLANTS IN TEXAS

Although silver is the only one of the five metals reviewed in this chapter of which Texas is a large producer, the State derives much benefit through its smelting and refining industries from silver and

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other metals produced outside the State. Custom smelters of the American Smelting & Refining Co. in Texas furnished a market for ores and concentrates from eight Western States in 1938. The copper and lead plants at El Paso treated gold, silver, copper, and lead ores and concentrates from Arizona, California, Colorado, New Mexico, and Texas and lead ore in bond from Mexico. The natural-gas-retort zinc-smelting plant at Amarillo treated zinc concentrates from Arizona, Colorado, Idaho, Nevada, New Mexico, and Utah. The Illinois Zinc Co. horizontal-retort zinc smelter 5 miles northeast of Dumas was run on lead-free zinc concentrates from the Peru mill at Deming, N. Mex., and on other zinc concentrates received from operators in Washington and the Tri-State district of Oklahoma, Kansas, and Missouri.

The Nichols electrolytic copper refinery at El Paso continued in 1938 to treat copper anodes produced at the Arizona smelters of the Phelps Dodge Corporation. The plant is operated by the Nichols Copper Co., which since 1934 has been a unit of the Phelps Dodge Corporation. About 8,000 tons of anodes pass through the refinery monthly.

Natural gas is used for fuel by all the foregoing plants.

## MINES REVIEW BY COUNTIES

*Culberson County.*—Lessees working on the three upper levels of the Hazel mine, 16 miles northwest of Van Horn, from March 15 to December 31, 1938, shipped 373 tons of silver-copper ore to the El Paso smelter. The mine is developed by a vertical shaft 746 feet deep and about 5,000 feet of drifts, crosscuts, and raises. The drifts on each of the three upper levels are about 400 feet long. The lessees did 50 feet of sinking on a new shaft in 1938. A 5-ton lot of copper-silver ore was shipped from another property in Culberson County during the year.

*Hudspeth County.*—Siliceous silver ore containing some copper, shipped to the El Paso smelter from the Plata Verde mine 14 miles by road southwest of Van Horn, yielded most of the metal output of Hudspeth County in 1938. The mine was operated by the owners, Drunzer and Buchholtz, at a reduced tonnage rate after the lessees relinquished it on January 15. A lessee at the Black Shaft mine in the Allamoore district shipped 54 tons of copper-silver ore to the El Paso smelter early in the year. A small lot of lead-silver ore was shipped to the smelter from each of two properties near Sierra Blanca.

*Presidio County.*—The American Metal Co. of Texas operated its Presidio silver mine at Shafter continuously in 1938. The mine is developed by two vertical shafts, one 400 feet and one 700 feet deep; two underground subshafts, one 100 feet and one 200 feet deep; and eight levels with stopes, raises, and other openings totaling more than 50 miles of underground workings. Development work in 1938 totaled 9,036 feet, of which 6,747 feet were prospecting, and diamond drilling totaled 30,127 feet. The ore is found as a replacement of limestone beds and is oxidized, the principal mineral being silver chloride associated with argentite, cerargyrite, galena, anglesite, and cerussite. A rail tramway runs from the west shaft to the east shaft, which is connected by aerial tramway with the company 350-ton gravity concentration-cyanidation mill at Shafter, 1 mile away. The

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ore is crushed to one-quarter inch size and then slimed to 65 percent minus 200-mesh in ball mills, grinding in cyanide solution. Minus 6-mesh material is screened out before grinding and tabled for lead-silver concentrates. Part of the ball-mill circulating load is also passed over tables. The pulp is agitated in Pachuca tanks, and then it passes through a series of thickeners for washing and decantation. The last thickener underflow is filtered before going to waste. The silver-bearing solutions are clarified and precipitated, using zinc dust. In 1938 the mill produced 685 tons of table concentrates averaging 0.079 ounce of gold and 405.82 ounces of silver to the ton and 49.95 percent lead. The concentrates and precipitates were shipped to the Carteret (N. J.) smelter. Electric power for the mine and mill is obtained from a 1,200-horsepower Diesel plant.

*Production of silver from the Presidio mine,*[1] *1885–1938* [2]

| Period | Mill heads treated (short tons) | Silver content of mill heads (ounces) | | Recovery of silver | |
|---|---|---|---|---|---|
| | | Per ton | Total | Percent | Ounces |
| 1885-1912 | 450,000 | 25.84 | 11,628,000 | 81.68 | 9,497,750 |
| 1913-26 | 720,000 | 12.00 | 8,640,000 | 83.66 | 7,228,224 |
| 1927 | 48,190 | 22.87 | 1,102,105 | 91.41 | 1,007,434 |
| 1928 | 57,475 | 23.17 | 1,331,696 | 91.04 | 1,212,340 |
| 1929 | 54,644 | 19.74 | 1,078,673 | 90.30 | 974,049 |
| Total, 1885-1929 | 1,330,309 | 17.88 | 23,780,474 | 83.77 | 19,919,797 |
| 1930 | 24,985 | 16.09 | 401,926 | 88.79 | 356,854 |
| 1934 | 46,653 | 19.70 | 919,064 | 91.39 | 839,936 |
| 1935 | 70,166 | 15.87 | 1,113,686 | 87.84 | 978,303 |
| 1936 | 98,499 | 14.41 | 1,419,371 | 87.48 | 1,241,605 |
| 1937 | 110,220 | 12.76 | 1,406,825 | 86.79 | 1,220,921 |
| 1938 | 127,574 | 12.76 | 1,627,844 | 84.72 | 1,379,187 |
| Total, 1885-1938 | 1,808,406 | 16.96 | 30,669,190 | 84.57 | 25,936,603 |

[1] Howbert, Van Dyne, and Gray, F. E., Milling Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 368, 1930.
Howbert, Van Dyne, and Bosustow, Robert, Mining Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 334, 1930.
[2] No production in 1931, 1932, and 1933.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By T. H. Miller and Paul Luff

## SUMMARY OUTLINE


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The value of the metal production in Utah in 1938 was $43,745,902, or slightly less than half the value of the 1937 output. The pronounced recession was caused by lower average metal prices combined with curtailed output of copper ore at Bingham and zinc-lead ore at Park City. There were decreases in all five metals, especially copper which declined from a record output of 411,988,000 pounds in 1937 to 216,252,000 pounds in 1938; the total value of the copper dropped 57 percent.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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*Mine production of gold, silver, copper, lead, and zinc in Utah, 1934–38, and total, 1864–1938, in terms of recovered metals*

| Year | Mines producing | | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 190 | 28 | 5,076,735 | 136,581.52 | $4,773,524 | 7,111,417 | $4,597,280 |
| 1935 | 203 | 31 | 7,771,596 | 184,759.80 | 6,466,593 | 9,206,329 | 6,617,049 |
| 1936 | 171 | 28 | 14,997,892 | 223,444.00 | 7,820,540 | 9,997,645 | 7,743,176 |
| 1937 | 189 | 14 | 24,578,275 | 322,759.00 | 11,296,565 | 12,869,117 | 9,954,262 |
| 1938 | 183 | 22 | 13,248,660 | 200,630.00 | 7,022,050 | 9,682,732 | 6,259,544 |
| 1864–1938 | ---------- | ---------- | (1) | 8,068,483.00 | 182,621,945 | 646,973,710 | 472,693,109 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 86,024,925 | $6,881,994 | 116,153,945 | $4,297,696 | 56,396,279 | $2,425,040 | $22,975,534 |
| 1935 | 129,515,217 | 10,749,763 | 127,019,175 | 5,080,767 | 62,213,614 | 2,737,399 | 31,651,571 |
| 1936 | 252,434,000 | 23,223,928 | 139,772,000 | 6,429,512 | 72,384,000 | 3,619,200 | 48,836,356 |
| 1937 | 411,988,000 | 49,850,548 | 178,916,000 | 10,556,044 | 96,002,000 | 6,240,130 | 87,897,549 |
| 1938 | 216,252,000 | 21,192,696 | 131,314,000 | 6,040,444 | 67,316,000 | 3,231,168 | 43,745,902 |
| 1864–1938 | [2] 2,975,934 | 888,361,189 | [2] 3,944,883 | 425,850,932 | [2] 669,298 | 80,427,285 | 2,049,954,460 |

[1] 1864–1901: Figures not available; 1902–38: 340,379,723 tons produced.
[2] Short tons.

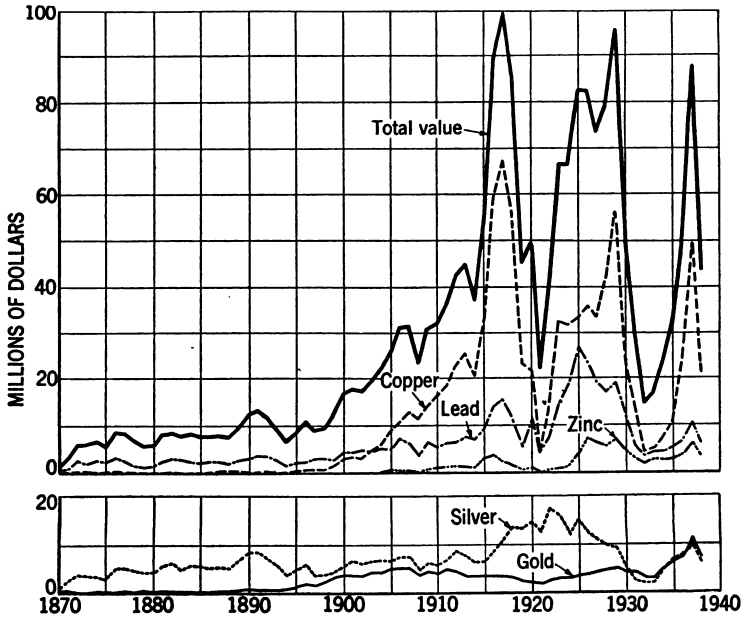


FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Utah, 1870–1938.

*Gold.*—The output of gold in Utah fell 122,129 ounces in 1938; gold from copper ore declined more than 104,000 ounces as a result of curtailment by the Utah Copper Co., and there were also decreases in gold from all other classes of ore. Copper ore yielded 49 percent

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of the total, siliceous ore 35 percent, and zinc-lead ore 13 percent; ore of all classes treated at concentration mills yielded 62 percent, crude ore smelted nearly 30 percent, and ore to amalgamation and cyanidation mills 8 percent. Mines in the West Mountain district produced 64 percent of the total gold, despite a decrease of 110,759 ounces in the district output. The Utah Copper Co. was, as usual, the largest gold producer in Utah, followed by the United States & Lark, Con Mercur, Mammoth, and Eureka Standard mines; these five mines yielded nearly 74 percent of the total gold.

*Silver.*—The output of silver in Utah in 1938 was 3,186,385 ounces less than in 1937. Production from the Bingham district decreased 1,201,685 ounces, chiefly as a result of curtailment by the Utah Copper Co.; and that from Park City declined 1,169,976 ounces, as increases at the Park City Consolidated and Park Galena properties were more than offset by large decreases caused by the closing of the Silver King Coalition and Park Utah Consolidated properties. The yield of silver from the Tintic district was 520,792 ounces less than in 1937, due to decreases at nearly all the large producers in the district. Zinc-lead ore yielded 47 percent of the total silver from Utah, siliceous ore nearly 32 percent, lead ore 12 percent, and copper ore 9 percent. Nearly 57 percent of the total came from ore milled and 43 percent from crude ore smelted. The United States & Lark mine at Bingham was again the largest silver producer in Utah, followed by the Tintic Standard, Park City Consolidated, Utah Copper, and Silver King Coalition properties; these five properties produced nearly 70 percent of the total silver.

*Copper.*—Suspension of operations by the Utah Copper Co. for 6 weeks during June and July 1938 and curtailment in the rate of operations for the rest of the year caused a decrease in output of copper ore by the company from 23,119,800 tons in 1937 to 11,704,900 tons in 1938. As a result, recoverable copper produced in Utah declined from 411,988,000 to 216,252,000 pounds. An increase in copper production was reported by the Ohio Copper Co. due to full-year operation of the mill completed late in 1937. Copper ore and mine-water precipitates yielded nearly 96 percent of the total copper, and most of the remainder came from zinc-lead ore milled and siliceous ore smelted.

*Lead.*—The output of recoverable lead in Utah fell from 178,916,000 pounds in 1937 to 131,314,000 pounds in 1938. Most of the decrease was in zinc-lead ore from Park City, due to the closing of the Silver King Coalition and Park Utah Consolidated properties, but there were also decreases in the Bingham, Tintic, Ophir, and Rush Valley districts. Zinc-lead ore yielded 72 percent of the total, lead ore 21 percent, and siliceous ore 6 percent; ore milled and smelted yielded 73 percent of total and ore smelted direct 27 percent. The United States & Lark mine at Bingham was, as usual, the largest producer of lead in Utah, followed by the Tintic Standard, Silver King Coalition, Boston Consolidated, and West Calumet properties; these five mines produced 74 percent of the State total.

*Zinc.*—The output of recoverable zinc in Utah decreased 28,686,000 pounds in 1938. Production from Park City declined more than 27,300,000 pounds and that from Tooele County also decreased, but output from the Bingham district increased slightly. Zinc ore and

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zinc-lead ore shipped crude to smelters yielded 96,079 pounds of recoverable zinc, and the remainder of the zinc came from complex zinc-lead-iron ore treated in four flotation plants. The United States & Lark, Silver King Coalition, West Calumet, Hidden Treasure, and Park City Consolidated mines were the leading zinc producers in Utah in 1938; these five mines produced 84 percent of the total zinc.

## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Utah in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Ore | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | Short tons | Fine ounces | Value | Fine ounces | Value |
| Beaver | 16 | | 5,509 | 739 | $25,865 | 33,513 | $21,665 |
| Box Elder | 8 | | 182 | 33 | 1,155 | 3,182 | 2,057 |
| Garfield | | 5 | | 26 | 910 | | |
| Grand | 1 | 5 | 3 | 23 | 805 | 68 | 44 |
| Iron | 8 | | 1,255 | 562 | 19,670 | 4,902 | 3,169 |
| Juab | 22 | | 155,492 | 19,521 | 683,235 | 958,436 | 619,595 |
| Millard | 3 | 1 | 66 | 12 | 420 | 48 | 31 |
| Piute | 12 | | 9,359 | 1,497 | 52,395 | 19,933 | 12,886 |
| Salt Lake | 23 | | 12,510,929 | 129,670 | 4,538,450 | 3,710,916 | 2,398,976 |
| San Juan | 2 | 2 | 149 | 19 | 665 | 181 | 117 |
| Sevier | 1 | | 21 | 31 | 1,085 | 1,717 | 1,110 |
| Summit | 8 | | 46,683 | 1,107 | 38,745 | 536,843 | 347,050 |
| Tooele | 55 | | 275,995 | 25,584 | 895,440 | 405,982 | 262,453 |
| Uintah | 3 | 9 | 11 | 76 | 2,660 | 20 | 13 |
| Utah | 16 | | 140,429 | 17,159 | 600,565 | 2,581,227 | 1,668,672 |
| Wasatch | 4 | | 102,430 | 4,571 | 159,985 | 1,425,733 | 921,686 |
| Washington | 1 | | 147 | | | 31 | 20 |
| Total, 1937 | 183 | 22 | 13,248,660 | [1] 200,630 | 7,022,050 | 9,682,732 | 6,259,544 |
| | 189 | 14 | 24,578,275 | [2] 322,759 | 11,296,565 | 12,869,117 | 9,954,262 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Beaver | 17,755 | $1,740 | 392,500 | $18,055 | 21,604 | $1,037 | $68,362 |
| Box Elder | 102 | 10 | 15,913 | 732 | | | 3,954 |
| Garfield | | | | | | | 910 |
| Grand | 398 | 39 | | | | | 888 |
| Iron | | | | | | | 22,839 |
| Juab | 1,239,500 | 121,471 | 4,596,848 | 211,455 | 730,521 | 35,065 | 1,670,821 |
| Millard | 1,184 | 116 | 2,413 | 111 | | | 678 |
| Piute | 5,714 | 560 | 23,978 | 1,103 | | | 66,944 |
| Salt Lake | 212,188,449 | 20,794,468 | 83,248,587 | 3,829,435 | 46,257,479 | 2,220,359 | 33,781,688 |
| San Juan | 12,255 | 1,201 | | | | | 1,983 |
| Sevier | | | | | | | 2,195 |
| Summit | 180,643 | 17,703 | 7,707,174 | 354,530 | 5,255,063 | 252,243 | 1,010,271 |
| Tooele | 1,032,102 | 101,146 | 13,539,370 | 622,811 | 7,752,583 | 372,124 | 2,253,974 |
| Uintah | 1,235 | 121 | 1,261 | 58 | | | 2,852 |
| Utah | 1,152,214 | 112,917 | 14,977,478 | 688,964 | 1,196,958 | 57,454 | 3,128,572 |
| Wasatch | 349,398 | 34,241 | 6,808,478 | 313,190 | 6,101,792 | 292,886 | 1,721,988 |
| Washington | 71,051 | 6,963 | | | | | 6,983 |
| Total, 1937 | 216,252,000 | 21,192,696 | 131,314,000 | 6,040,444 | 67,316,000 | 3,231,168 | 43,745,902 |
| | 411,988,000 | 49,850,548 | 178,916,000 | 10,556,044 | 96,002,000 | 6,240,130 | 87,897,541 |

[1] Includes 148 ounces of placer gold distributed as follows: Garfield County, 26 ounces; Grand County, 23 ounces; Millard County, 5 ounces; San Juan County, 18 ounces; and Uintah County, 76 ounces.
[2] Includes 55 ounces of placer gold.

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## MINING INDUSTRY

Curtailment by the Utah Copper Co. at Bingham and closing of the Silver King Coalition and Park Utah Consolidated properties at Park City resulted in marked decreases in the output of copper, lead, and zinc in Utah in 1938; the output of gold and silver also decreased as the larger part of the gold and silver from Utah comes from copper ore and zinc-lead ore. Most of the decrease was in the Bingham and Park City areas, but output in the Tintic, Ophir, and Rush Valley districts also decreased. There was an important increase in output of gold ore at Mercur.

Work of driving the Elton tunnel from Tooele to the Apex-Delaware group in the Bingham district was continued during 1938 by National Tunnel & Mines Co.; the adit was about one-fourth completed at the end of the year. The Bingham-Copperfield vehicular tunnel was completed by the Utah Copper Co. and placed in operation early in 1939. Other mine development and plant improvements of importance included the Thaynes shaft work by the Silver King Coalition Mines Co., enlargement of the Geyser Marion cyanide mill at Mercur, and erection of a 600-ton flotation plant at the Ophir Hill tailings dump.

### ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore sold or treated in Utah in 1938, with content in terms of recovered metals*

| Source | Mines producing | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 50 | 283,472 | 41,381 | 326,711 | 708,936 | 1,019,338 | ---------- |
| Dry and siliceous gold-silver ore | 20 | 184,346 | 24,620 | 1,050,385 | 2,682,675 | 3,049,967 | ---------- |
| Dry and siliceous silver ore | 29 | 92,543 | 4,265 | 1,698,153 | 861,575 | 4,409,627 | ---------- |
| | 99 | 560,361 | 70,266 | 3,075,249 | 4,253,186 | 8,478,932 | ---------- |
| Copper ore | 14 | 12,032,385 | 98,100 | 919,224 | [1] 207,014,357 | 6,285 | ---------- |
| Lead ore | 79 | 94,883 | 5,314 | 1,112,585 | 735,328 | 27,697,916 | ---------- |
| Zinc ore | 1 | 83 | ---------- | ---------- | ---------- | 3,160 | 40,979 |
| Zinc-lead ore | 31 | 560,948 | 26,802 | 4,575,668 | 4,249,129 | 95,127,707 | 67,275,021 |
| Total, lode mines | [2] 183 | 13,248,660 | 200,482 | 9,682,726 | [1] 216,252,000 | 131,314,000 | 67,316,000 |
| Total, placers | 22 | ---------- | 148 | 6 | ---------- | ---------- | ---------- |
| | 205 | 13,248,660 | 200,630 | 9,682,732 | [1] 216,252,000 | 131,314,000 | 67,316,000 |
| Total, 1937 | 203 | 24,578,275 | 322,759 | 12,869,117 | [3] 411,988,000 | 178,916,000 | 96,002,000 |

[1] Includes 10,220,878 pounds recovered from precipitates.
[2] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[3] Includes 4,839,088 pounds recovered from precipitates.

## METALLURGIC INDUSTRY

The 13,248,660 tons of ore produced in Utah in 1938 comprised 197,936 tons of ore treated at amalgamation and cyanidation mills (an increase from 127,288 tons in 1937), 12,597,042 tons treated at concentration plants (a marked decrease from 23,941,803 tons in 1937), and 453,682 tons shipped crude to smelters (compared with 509,184 tons in 1937).

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Four gold and silver mills were operated in Utah in 1938. One small straight amalgamation mill in Box Elder County and one combined amalgamation and concentration plant in Piute County treated 7,624 tons of ore. Two cyanidation mills at Mercur, Tooele County—one of them also equipped for flotation concentration—treated 190,312 tons of ore; the ore treated at these cyanidation plants contained (gross assay) 21,464 ounces of gold and 1,110 ounces of silver, indicating recoveries (in bullion and concentrates) of nearly 74 percent of the gold and 61 percent of the silver. The plants used 87,266 pounds of sodium cyanide (91-percent grade), 38,106 pounds of zinc dust, and 646,330 pounds of lime.

Eight concentration plants (all straight flotation) were operated in Utah in 1938. Three plants (Magna, Arthur, and Ohio Copper) treated 12,031,615 tons of copper ore and old tailings, one (Ophir) treated 4,596 tons of lead tailings, and four (Bauer, Midvale, Tooele, and Silver King) treated 560,831 tons of zinc-lead ore.

The following tables give details of treatment for all the ore produced in Utah in 1938.

*Mine production of metals in Utah in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Meterial treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore amalgamated | 7,624 | 381 | 250 | | | |
| Ore cyanided | 190,312 | 14,391 | 634 | | | |
| Concentrates smelted [1] | 546,903 | 126,526 | 5,504,390 | 200,941,529 | 95,229,226 | 67,219,921 |
| Ore smelted | 453,682 | 59,184 | 4,177,452 | 5,089,593 | 36,084,774 | 96,079 |
| Mine-water precipitates smelted [2] | 6,607 | | | 10,220,878 | | |
| Placer | | 148 | 6 | | | |
| Total, 1937 | | 200,630 | 9,682,732 | 216,252,000 | 131,314,000 | 67,316,000 |
| | | 322,759 | 12,869,117 | 411,988,000 | 178,916,000 | 96,002,000 |

[1] Includes zinc concentrates treated at electrolytic plants.
[2] All from Salt Lake County.

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Utah in 1938, by types of mills and by counties, in terms of recovered metals*

AMALGAMATION MILLS

| County | Ore treated | Recovered in bullion | | Concentrates smelted and recovered metal | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* |
| Box Elder | 50 | 23 | 8 | | | |
| Piute | 7,574 | 358 | 242 | 16 | 259 | 2,106 |
| Total, 1937 | 7,624 | 381 | 250 | 16 | 259 | 2.10 |
| | 20,538 | 2,186 | 2,646 | 47 | 641 | 5,599 |

CYANIDATION MILLS

| | | | | | | |
|---|---|---|---|---|---|---|
| Tooele | 190,312 | 14,391 | 634 | 904 | 1,385 | 38 |
| Total, 1937 | 190,312 | 14,391 | 634 | 904 | 1,385 | 38 |
| | 106,750 | 9,319 | 1,477 | 524 | 1,136 | 130 |
| Grand total: 1938 | 197,936 | 14,772 | 884 | 920 | 1,644 | 2,144 |
| 1937 | 127,288 | 11,505 | 4,123 | 571 | 1,777 | 5,729 |

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*Mine production of metals from concentrating mills in Utah in 1938, by counties, in terms of recovered metals*

| County | Ore milled | Concentrates (to smelters and electrolytic plants) and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|
| | | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Beaver | 96 | 56 | 2 | 313 | 524 | 20,042 | 21,604 |
| Juab | 3,639 | 1,417 | 36 | 24,268 | 8,996 | 386,847 | 730,521 |
| Salt Lake | 12,393,829 | 486,300 | 117,633 | 3,163,051 | 199,431,792 | 69,849,581 | 46,202,379 |
| Summit | 40,280 | 11,206 | 711 | 468,181 | 167,581 | 7,438,804 | 5,255,063 |
| Tooele | 47,987 | 23,603 | 1,427 | 302,229 | 927,827 | 8,858,901 | 7,711,604 |
| Utah | 8,853 | 4,377 | 503 | 119,541 | 55,979 | 1,872,158 | 1,196,958 |
| Wasatch | 102,358 | 19,024 | 4,570 | 1,424,663 | 348,830 | 6,802,893 | 6,101,792 |
| | 12,597,042 | 545,983 | 124,882 | 5,502,246 | 200,941,529 | 95,229,226 | 67,219,921 |
| Total, 1937 | 23,941,803 | 910,001 | 233,494 | 7,731,431 | 400,802,359 | 129,744,655 | 95,902,500 |

*Gross metal content of Utah concentrates produced in 1938, by classes of concentrates*

| Class of concentrates | Concentrates produced | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry gold | 920 | 1,644 | 2,144 | | | |
| Copper | 303,952 | 98,072 | 912,729 | 202,723,147 | | |
| Lead | 86,226 | 12,468 | 3,757,740 | 3,280,552 | 90,124,252 | 8,954,388 |
| Lead-copper | 553 | 8 | 13,849 | 59,770 | 151,988 | |
| Zinc | 69,706 | 3,543 | 442,428 | 1,074,120 | 5,933,919 | 74,689,574 |
| Iron (from zinc-lead ore) | 85,546 | 10,791 | 375,500 | 613,428 | 3,902,396 | 4,535,712 |
| | 546,903 | 126,526 | 5,504,390 | 207,751,017 | 100,112,555 | 88,179,674 |
| Total, 1937 | 910,572 | 235,271 | 7,737,160 | 414,346,461 | 137,242,800 | 128,093,433 |

*Mine production of metals from Utah concentrates in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Beaver | 56 | 2 | 313 | 524 | 20,042 | 21,604 |
| Juab | 1,417 | 36 | 24,268 | 8,996 | 386,847 | 730,521 |
| Piute | 16 | 259 | 2,106 | | | |
| Salt Lake | 486,300 | 117,633 | 3,163,051 | 199,431,792 | 69,849,581 | 46,202,379 |
| Summit | 11,206 | 711 | 468,181 | 167,581 | 7,438,804 | 5,255,063 |
| Tooele | 24,507 | 2,812 | 302,267 | 927,827 | 8,858,901 | 7,711,604 |
| Utah | 4,377 | 503 | 119,541 | 55,979 | 1,872,158 | 1,196,958 |
| Wasatch | 19,024 | 4,570 | 1,424,663 | 348,830 | 6,802,893 | 6,101,792 |
| | 546,903 | 126,526 | 5,504,390 | 200,941,529 | 95,229,226 | 67,219,921 |
| Total, 1937 | 910,572 | 235,271 | 7,737,160 | 400,802,359 | 129,744,655 | 95,902,500 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry gold | 920 | 1,644 | 2,144 | | | |
| Copper | 303,952 | 98,072 | 912,729 | 196,641,452 | | |
| Lead | 86,226 | 12,468 | 3,757,740 | 2,645,158 | 86,519,296 | |
| Lead-copper | 553 | 8 | 13,849 | 50,948 | 145,899 | |
| Zinc | 69,706 | 3,543 | 442,428 | 1,020,148 | 5,637,225 | 67,219,921 |
| Iron (from zinc-lead ore) | 85,546 | 10,791 | 375,500 | 583,823 | 2,926,806 | |
| | 546,903 | 126,526 | 5,504,390 | 200,941,529 | 95,229,226 | 67,219,921 |

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*Gross metal content of Utah crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold | 85,536 | 24,965 | 323,683 | 736,793 | 1,419,581 | |
| Dry and siliceous gold-silver | 184,346 | 24,620 | 1,050,385 | 2,765,447 | 4,371,173 | |
| Dry and siliceous silver | 92,543 | 4,265 | 1,698,153 | 888,255 | 6,277,996 | |
| Copper | 770 | 28 | 6,495 | 156,722 | 8,979 | |
| Lead | 90,287 | 5,306 | 1,098,736 | 828,679 | 28,724,269 | |
| Zinc | 83 | | | | 3,501 | 45,534 |
| Zinc-lead | 117 | | | | 55,421 | 61,209 |
| | 453,682 | 59,184 | 4,177,452 | 5,375,896 | 40,860,920 | 106,743 |
| Total, 1937 | 509,184 | 75,928 | 5,127,834 | 6,863,337 | 55,281,997 | 110,282 |

*Mine production of metals from Utah crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Beaver | 5,413 | 737 | 33,200 | 17,231 | 372,458 | |
| Box Elder | 132 | 10 | 3,174 | 102 | 15,913 | |
| Grand | 3 | | 65 | 398 | | |
| Iron | 1,255 | 562 | 4,902 | | | |
| Juab | 151,853 | 19,485 | 934,168 | 1,230,504 | 4,210,001 | |
| Millard | 66 | 7 | 48 | 1,184 | 2,413 | |
| Piute | 1,785 | 880 | 17,585 | 5,714 | 23,978 | |
| Salt Lake | 117,100 | 12,037 | 547,865 | 2,535,779 | 13,399,006 | 55,100 |
| San Juan | 149 | 1 | 181 | 12,255 | | |
| Sevier | 21 | 31 | 1,717 | | | |
| Summit | 6,403 | 396 | 68,662 | 13,062 | 268,370 | |
| Tooele | 37,696 | 8,381 | 103,081 | 104,275 | 4,680,469 | 40,979 |
| Uintah | 11 | | 17 | 1,235 | 1,261 | |
| Utah | 131,576 | 16,656 | 2,461,686 | 1,096,235 | 13,105,320 | |
| Wasatch | 72 | 1 | 1,070 | 568 | 5,585 | |
| Washington | 147 | | 31 | 71,051 | | |
| | 453,682 | 59,184 | 4,177,452 | 5,089,593 | 36,084,774 | 96,079 |
| Total, 1937 | 509,184 | 75,928 | 5,127,834 | 6,346,553 | 49,171,345 | 99,500 |

BY CLASSES OF ORE

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry and siliceous gold | 85,536 | 24,965 | 323,683 | 708,936 | 1,019,338 | |
| Dry and siliceous gold-silver | 184,346 | 24,620 | 1,050,385 | 2,682,675 | 3,049,967 | |
| Dry and siliceous silver | 92,543 | 4,265 | 1,698,153 | 861,575 | 4,409,627 | |
| Copper | 770 | 28 | 6,495 | 152,027 | 6,285 | |
| Lead | 90,287 | 5,306 | 1,098,736 | 684,380 | 27,552,017 | |
| Zinc | 83 | | | | 3,160 | 40,979 |
| Zinc-lead | 117 | | | | 44,380 | 55,100 |
| | 453,682 | 59,184 | 4,177,452 | 5,089,593 | 36,084,774 | 96,079 |

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in Utah in 1938, by counties and districts, in terms of recovered metals*

| County and district | Mines producing | | Ore | Gold | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | | | | | |
| Beaver County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Beaver Lake | 1 | | 117 | 2 | | 51 | 5,286 | | | $621 |
| Bradshaw | 1 | | 68 | 3 | | 2,045 | 51 | | | 1,432 |
| Lincoln | 1 | | 18 | | | 65 | 214 | 6,891 | 5,479 | 643 |
| Newton | 2 | | 32 | 22 | | 331 | 357 | 1,000 | | 1,065 |
| Pine Grove | 1 | | 36 | 8 | | 560 | | 11,500 | | 1,171 |
| San Francisco | 4 | | 4,917 | 698 | | 27,918 | 9,857 | 267,283 | 11,646 | 56,298 |
| Star and North Star | 6 | | 321 | 6 | | 2,543 | 1,990 | 105,826 | 4,479 | 7,132 |
| Box Elder County: | | | | | | | | | | |
| Ashbrook | 4 | | 96 | 8 | | 3,035 | 61 | 2,196 | | 2,349 |
| Grouse Creek | 1 | | 3 | | | 130 | 41 | 65 | | 91 |
| Lucin | 1 | | 32 | | | 3 | | 13,652 | | 630 |
| Park Valley | 2 | | 51 | 25 | | 14 | | | | 884 |
| Garfield County: Imperial | | 5 | | | 26 | | | | | 910 |
| Grand County: | | | | | | | | | | |
| Colorado River | | 4 | | | 17 | 3 | | | | 597 |
| Miners Basin | 1 | 1 | 3 | | 6 | 65 | 398 | | | 291 |
| Iron County: Stateline | 8 | | 1,255 | 562 | | 4,902 | | | | 22,839 |
| Juab County: | | | | | | | | | | |
| Detroit [1] | 1 | | 836 | 198 | | 1,089 | 17,316 | | | 9,331 |
| Fish Springs | 4 | | 195 | 1 | | 18,462 | 357 | 146,674 | | 18,752 |
| Spring Creek | 2 | | 95 | 3 | | 2,707 | 408 | 1,174 | | 1,949 |
| Tintic [2] | 14 | | 154,109 | 19,257 | | 934,956 | 1,220,521 | 4,396,500 | 730,521 | 1,635,326 |
| West Tintic | 1 | | 257 | 62 | | 1,222 | 898 | 52,500 | | 5,463 |
| Millard County: | | | | | | | | | | |
| Cricket Mountain | 1 | | 1 | | | | | 1,326 | | 61 |
| Detroit [1] | 1 | | 61 | 7 | | 48 | 1,184 | | | 392 |
| Leamington | 1 | | 4 | | | | | 1,087 | | 50 |
| Sawtooth Mountains | | 1 | | | 5 | | | | | 175 |
| Piute County: | | | | | | | | | | |
| Gold Mountain | 3 | | 7,647 | 761 | | 3,646 | | | | 28,992 |
| Mount Baldy | 1 | | 1,451 | 649 | | 12,822 | 3,000 | 9,413 | | 31,731 |
| Ohio | 8 | | 261 | 87 | | 3,465 | 2,714 | 14,565 | | 6,221 |
| Salt Lake County: | | | | | | | | | | |
| Big Cottonwood | 4 | | 1,016 | 38 | | 18,892 | 57,857 | 323,022 | 64,542 | 37,170 |
| Little Cottonwood | 5 | | 2,050 | 244 | | 20,230 | 32,092 | 257,326 | | 36,600 |
| West Mountain [3] | 14 | | 12,507,863 | 129,388 | | 3,671,794 | 212,098,500 | 82,668,239 | 46,192,937 | 33,707,918 |

See footnotes at end of table.

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*Mine production of gold, silver, copper, lead, and zinc in Utah in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mines producing | | Ore | Gold | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | | | | | |
| San Juan County: | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Colorado River | | 2 | | | 18 | | | | | $630 |
| La Sal | 2 | | 149 | 1 | | 181 | 12,255 | | | 1,353 |
| Sevier County: Henry | 1 | | 21 | 31 | | 1,717 | | | | 2,195 |
| Summit County: Uintah | 8 | | 46,683 | 1,107 | | 536,843 | 180,643 | 7,707,174 | 5,255,063 | 1,010,271 |
| Tooele County: | | | | | | | | | | |
| Camp Floyd | 10 | | 211,983 | 23,001 | | 1,253 | | | | 805,845 |
| Clifton | 8 | | 659 | 207 | | 7,210 | 3,816 | 89,370 | | 16,391 |
| Columbia | 1 | | 9 | | | 17 | | 1,500 | | 80 |
| Dugway | 3 | | 129 | | | 396 | | 44,609 | 14,896 | 3,023 |
| Free Coinage | 1 | | 114 | | | 430 | | 55,587 | | 2,835 |
| Lakeside | 3 | | 149 | | | 198 | 204 | 58,478 | | 2,838 |
| North Tintic | 1 | | 118 | | | 65 | 51 | 18,739 | 40,979 | 2,876 |
| Ophir | 13 | | 21,242 | 140 | | 144,919 | 874,102 | 4,025,543 | 3,786,812 | 551,189 |
| Rush Valley | 8 | | 41,511 | 2,173 | | 250,883 | 153,643 | 9,238,000 | 3,909,896 | 865,922 |
| Silver Islet | 1 | | 23 | | | 447 | 286 | 5,500 | | 570 |
| West Mountain[3] | 1 | | 26 | 8 | | 34 | | | | 302 |
| Willow Springs | 5 | | 32 | 55 | | 130 | | 2,044 | | 2,103 |
| Uintah County: | | | | | | | | | | |
| Carbonate | 3 | | 11 | | | 17 | 1,235 | 1,261 | | 190 |
| Green River | | 9 | | | 76 | 3 | | | | 2,662 |
| Utah County: | | | | | | | | | | |
| American Fork | 5 | | 1,110 | 268 | | 6,551 | 18,765 | 164,739 | 85,021 | 27,113 |
| Tintic[2] | 11 | | 139,319 | 16,891 | | 2,574,676 | 1,133,449 | 14,812,739 | 1,111,937 | 3,101,459 |
| Wasatch County: | | | | | | | | | | |
| Blue Ledge | 2 | | 90,619 | 4,429 | | 1,362,520 | 344,612 | 4,673,391 | 3,678,854 | 1,461,169 |
| Snake Creek | 2 | | 11,811 | 142 | | 63,213 | 4,786 | 2,135,087 | 2,422,938 | 260,819 |
| Washington County: Tutsagubet | 1 | | 147 | | | 31 | 71,051 | | | 6,983 |
| Total Utah | 183 | 22 | 13,248,660 | 200,482 | 148 | 9,682,732 | 216,252,000 | 131,314,000 | 67,316,000 | 43,745,902 |

[1] Detroit district lies in both Juab and Millard Counties.
[2] Tintic district lies in both Juab and Utah Counties.
[3] West Mountain district lies in both Salt Lake and Tooele Counties.

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### BEAVER COUNTY

Lessees continued operations at the Horn Silver mine at Frisco during 1938 and shipped 4,811 tons of ore, chiefly gold-silver ore for smelting; no new development was under way, but the Horn Silver Mines Co. reconditioned and reopened the shaft to the 500-foot level. The remainder of the output from Beaver County comprised small lots of zinc-lead ore shipped to the custom mill at Midvale from the Lincoln, Horn Silver, and Moscow mines and ore shipped for smelting from several properties, including the O. K., Honey Boy, Sheep Rock, Revenue, Frisco Silver-Lead, Quad Metals, Cactus, Good Luck, Beaver Crown, Moscow, Atlas, and Silver Draw.

### BOX ELDER COUNTY

The output of silver from Box Elder County decreased markedly in 1938, as lessees at the Vipont mine in the Ashbrook district suspended shipments of silver ore; only 30 tons were shipped compared with more than 1,000 tons in 1937. The remainder of the county output comprised silver ore from the Apex and Liberty Bell (Skoro), Utah-Idaho, and Gold Lead mines; lead ore from the Comstock mine near Lucin; and gold ore from the Raft River and Susannah properties. A small amalgamation plant was operated at the Susannah property for a short time.

### IRON COUNTY

The value of the metal output from mines in Iron County in 1938 was less than half that in 1937. The entire output was dry and siliceous ore shipped for smelting; it comprised gold ore from the Creole, Gold Hill, Raindrop, Wonder, Surprise, Genter, and Pipe Dream mines and silver ore from the Ophir property.

### JUAB COUNTY

*Tintic district.*—The Tintic district lies in both Juab and Utah Counties, and the mines in both sections are reviewed here. The table that follows gives the metal production in each section in 1938, a comparison of the total with that for 1937, and the total output of the district from 1869 to 1938. The table indicates a decrease in the output of all five metals, mostly at mines in the eastern (Utah County) section.

*Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1937–38, and total, 1869–1938, in terms of recovered metals*

| | Mines producing | Ore | Gold | Silver | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|
| 1938 | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Juab County | 14 | 154,109 | 19,257 | 934,956 | 1,220,521 | 4,396,500 | 730,521 | $1,635,326 |
| Utah County | 11 | 139,319 | 16,891 | 2,574,676 | 1,133,449 | 14,812,739 | 1,111,937 | 3,101,459 |
| Total, 1937 | 25 | 293,428 | 36,148 | 3,509,632 | 2,353,970 | 19,209,239 | 1,842,458 | 4,736,785 |
| | 34 | 310,582 | 51,069 | 4,030,424 | 2,662,000 | 20,396,000 | 2,517,600 | 6,594,058 |
| Total, 1869–1938 | | [1] | 2,394,527 | 244,532,264 | 229,422,014 | 1,748,854,741 | 36,999,120 | 363,133,791 |

[1] Figures not available.



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The Chief Consolidated Mining Co. continued operations in 1938 at the Chief No. 1, Gemini, Eureka Hill, and Plutus mines in Juab County and the Apex Standard mine in Utah County. According to the company printed annual report the output from Juab County comprised 1,464 tons of lead ore, 13,188 tons of silver ore, and 3,827 tons of zinc-lead ore from the Chief No. 1 mine; 4,083 tons of silver ore from the Gemini mine; 2,090 tons of silver ore from the Eureka Hill mine; and 308 tons of lead ore and 2,158 tons of silver ore from the Plutus mine. Total metal production from all mines was given as follows: Gold, 1,575 ounces; silver, 307,696 ounces; copper, 106,233 pounds; lead, 1,278,101 pounds; and zinc, 816,749 pounds. The company reported 3,099 feet of development in the Chief No. 1 mine and 2,564 feet in the Plutus mine. The Centennial-Beck, Victoria, and Eagle & Blue Bell properties were operated continuously by the United States Smelting, Refining & Mining Co.; all the output was crude ore shipped for smelting and comprised about 43,800 tons of gold-silver ore and about 2,900 tons of lead ore, approximately the same as was produced in 1937. The Mammoth Mining Co. operated its property the entire year and produced nearly 40,000 tons of ore (chiefly gold-silver ore) shipped for smelting, a decrease of about 9,000 tons from the 1937 output; development of about 1,100 feet was reported, and dividends totaling $39,532 were paid. The American Smelting & Refining Co. reconditioned the Grand Central mine during 1937 and in 1938 operated from January until the end of August, producing highly siliceous gold-silver ore used as converter flux at the Garfield smelter; company and lessee production totaled more than 28,000 tons of ore, a marked increase over the 1937 output. The remainder of the output from the Juab County section of the Tintic district was crude ore shipped for smelting from the Godiva (3,144 tons of gold ore), Dragon & Martha Washington, Empire Star, Showers, Black Jack, and other properties.

Producing mines in the Utah County section of the Tintic district in 1938 included the Apex Standard, Colorado, Eureka Lilly, Eureka Standard, May Day, North Lily, Tintic Bullion, Tintic Standard, Yankee, and Zuma properties. The Tintic Standard Mining Co. reported an increase in output at the Tintic Standard and Colorado mines, but decreases were reported at the Eureka Standard and Eureka Lilly mines. The following details of shipments by mines and classes of ore were reported in the company printed annual report: Tintic Standard mines, 26,429 tons of lead ore and 57,137 tons of siliceous ore; Eureka Standard mine, 19,659 tons of siliceous ore and 6,252 tons of zinc-lead ore; Eureka Lilly mine, 2,102 tons of siliceous ore and 971 tons of lead ore; and Colorado Consolidated mine, 2,964 tons of siliceous ore. About 11,500 feet of development were reported, chiefly in the Tintic Standard and Eureka Standard mines, and dividends amounting to $342,027 were paid. Development at the Eureka Standard mine opened a body of zinc-lead ore in the Ophir limestone, from which shipments were first made in 1938; prior to this important discovery the entire output of the mine was siliceous gold ore from fissure veins in quartzite. The Tintic Standard mine ranked second in output of silver and lead in Utah in 1938. The North Lily Mining Co. operated the North Lily and Tintic Bullion mines the entire year; each mine produced gold-silver ore and lead ore shipped for smelting and zinc-lead ore sent to the flotation mill at Tooele. The output

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from the Tintic Bullion mine increased markedly. The remainder of the output from the Utah County section of the Tintic district was ore of smelting grade from the Apex Standard, May Day (Mountain View), Yankee, and Zuma mines and a car of old tailings from the Harold dump of the Standard Reduction Co.

Production from outlying districts in Juab County in 1938 comprised gold ore from the Ibex mine in the Detroit district; rich silver-lead ore from the Emma, Galena, Utah & Last Chance, and Carnation mines at Fish Springs; siliceous ore from the Gold Bond and Premier mines near Spring Creek; and lead ore from the Scotia group in the West Tintic district.

### PIUTE COUNTY

The value of the metal output from Piute County dropped more than $110,000 in 1938 due to decreased output of gold ore from the Annie Laurie mine in the Gold Mountain district. The property was operated intermittently by Allied Annie Laurie Gold Mines, Inc., but the ore milled declined from about 20,000 tons in 1937 to 7,574 tons in 1938. Siliceous ore was shipped for smelting from the General Connor and Antler mines in the Gold Mountain district. The Deer Trail mine was closed during part of 1938; lessees shipped 1,451 tons of gold ore for smelting, a decrease from 2,140 tons in 1937. Ore was shipped for smelting from several mines in the Ohio district, including the Gold Strike, Tushar, Bully Boy, Wedge, Desert, Great Western, and Yellow Congo properties.

### SALT LAKE COUNTY

Production from the Big Cottonwood district decreased sharply in 1938, as lessees' output from the Cardiff mine was much less than in 1937; other producers were the Wasatch Gold Mines, Inc., Prince of Wales, and Tar Baby properties. In the Little Cottonwood district the Alta United, Columbus, Columbus Rexall, Dipper, and Michigan Utah properties were productive.

*Bingham or West Mountain district.*—The Bingham district is by far the most important mineral-producing area in Utah, and in 1938 its mines yielded metals valued at $33,707,918, or 77 percent of the State total; the value of the district output, however, decreased 51 percent from that in 1937. The quantity of copper decreased 48 percent, gold 46 percent, silver 25 percent, and lead 9 percent, but zinc increased 12 percent. The following table gives the production from mines at Bingham in 1937 and 1938 and the total from 1865 to 1938.

*Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1937–38, and total, 1865–1938, in terms of recovered metals*

| Year | Mines producing | Ore | Gold (lode and placer) | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| 1937 | 15 | 23,720,375 | 240,147 | 4,873,479 | 406,842,000 | 90,466,000 | 41,139,200 | $69,414,205 |
| 1938 | 14 | 12,507,863 | 129,388 | 3,671,794 | 212,098,500 | 82,668,239 | 46,192,937 | 33,707,918 |
| Total, 1865–1938 | | [1] | 3,748,697 | 108,258,105 | [2] 2,764,853 | [2] 1,311,151 | [2] 329,077 | 1,164,623,948 |

[1] Figures not available. [2] Short tons.

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Most of the decrease in gold, silver, and copper from the Bingham district in 1938 was caused by curtailment by the Utah Copper Co.; the open-cut mine and the Magna and Arthur mills operated at a curtailed rate from January until June 15, when all production was suspended. Operations were resumed August 1 and continued at a reduced rate for the remainder of the year. The company mined and milled 11,704,900 tons of ore in 1938 compared with 23,119,800 tons in 1937, and there were similar decreases in output of copper, gold, silver, and molybdenum. The new vehicular tunnel connecting Bingham and Copperfield was completed and placed in operation in February 1939. The 7,000-foot bore constructed by the Utah Copper Co. at a cost of about $1,400,000 will be used to divert vehicular and pedestrian traffic around the pit, closing the road crossing the pit and allowing bench mining to be started on that side. The American Smelting & Refining Co. operated the Boston Consolidated property of the Utah Copper Co. the entire year; the output comprised about 44,500 tons of smelting ore (gold-silver ore and lead ore) and about 700 tons of zinc-lead ore sent to Midvale for milling.

The United States Smelting, Refining & Mining Co. operated the entire year at the United States & Lark, Niagara, Bingham Metals, and Montana-Bingham properties at Bingham. The output of gold, silver, and lead decreased slightly compared with 1937, but the output of zinc increased considerably owing to higher average content of the ore treated at the Midvale mill. Most of the production was zinc-lead ore from the United States & Lark mine; the property ranked first in output of silver, lead, and zinc in Utah in 1938 and second in gold and copper.

The Ohio Copper Co. operated the new 1,000-ton flotation plant the entire year and treated 326,715 tons of old tailings from former milling operations. According to the company printed annual report, production in 1938 totaled 1,250,730 pounds of copper, 249 ounces of gold, and 3,116 ounces of silver. About 92 percent of the copper came from old tailings milled and the remainder from underground leaching operations on the Mascotte tunnel level.

The Apex-Delaware group was operated by National Tunnel & Mines Co. the entire year; part of the output was by lessees and part on company account. Nearly 40,000 tons of ore were produced, comprising gold ore and lead ore shipped for smelting and zinc-lead ore sent to the flotation mill near Tooele. Work of driving the Elton tunnel was seriously handicapped by a heavy flow of water in the unconsolidated gravel formation, but early in 1939 the bedrock limestone was entered and greater progress was reported; at the end of 1938 the tunnel was in about 6,200 feet of the projected 23,000 feet.

The Combined Metals Reduction Co. operated the Park-Bingham (Lavagnino) group in Butterfield Canyon the entire year, producing 6,770 tons of gold ore and 390 tons of lead ore shipped for smelting and 14,320 tons of zinc-lead ore shipped to the flotation plant at Bauer.

The remainder of the output from the West Mountain district in 1938 included a little zinc-lead ore from the Utah Metal & Tunnel property and a little copper ore from the Bingham Congor mine.

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## SUMMIT AND WASATCH COUNTIES

### PARK CITY REGION

The value of the metal output from mines in the Park City region in 1938 was about one-third that in 1937; the marked decrease was due chiefly to the closing of the Silver King Coalition property early in the year. The following table compares the production from the Park City region in 1937 and 1938 and shows the total for the period 1870 to 1938.

*Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1937–38, and total, 1870–1938, in terms of recovered metals*

| Year | Mines producing | Ore | Gold | Silver | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| 1937 | 11 | 286,128 | 7,033 | 3,132,552 | 845,215 | 44,833,712 | 38,683,200 | $7,931,052 |
| 1938 | 12 | 149,113 | 5,678 | 1,962,576 | 530,041 | 14,515,652 | 11,356,855 | 2,732,259 |
| Total, 1870–1938 | -------- | (1) | 429,790 | 217,834,168 | 59,699,840 | 2,186,999,307 | 499,397,045 | 317,903,566 |

[1] Figures not available.

Mining and milling at the Silver King Coalition Mines Co. were suspended April 30, 1938, and the property remained idle until May 1939. According to the company printed annual report production during the first 4 months of 1938 amounted to 35,919 tons of silver-lead-zinc milling ore and 97 tons of rich silver-lead ore of smelting grade; the output of silver, lead, and zinc was about one-fourth that in 1937. Shaft sinking at the new Thaynes shaft continued throughout the year, and at the end of the year the shaft was down 1,379 feet (a total of 907 feet of sinking in 1938); a connection was made on the 900 level of the Silver Hill section. Development at the Silver King property amounted to 9,080 feet. One quarterly dividend of $122,047 was paid April 1, 1938.

Operations at the properties of the Park Utah Consolidated Mines Co. in 1938 were reduced to a one-shift basis January 8 and were completely suspended May 5. As a result, production decreased to 19,144 tons in 1938 from 93,014 tons in 1937. Most of the output was zinc-lead ore shipped to the mill at Tooele from the Judge unit in Wasatch County and the Daly West and Judge properties in Summit County; ore of smelting grade was shipped from the Daly and Ontario properties in Summit County.

According to the printed annual report of the Park City Consolidated Mines Co. the output of silver-zinc-lead ore was 74,650 tons in 1938, an increase from 38,464 tons in 1937; a total of about 6,280 feet of development was done in 1938. The ore was shipped to the flotation plant at Midvale for treatment, and a substantial increase was recorded in output of silver; the property was the third-largest silver producer in Utah in 1938.

The New Park Mining Co., controlled by the Callahan Zinc-Lead Co., operated the entire year at the Park Galena property and shipped

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15,969 tons of zinc-lead ore to the mill at Midvale; development at the mine amounted to 1,861 feet, and arrangements were made to reopen the Mayflower tunnel and extend it about 1,600 feet to open the Park Galena fissure at a depth of 760 feet below the present main tunnel.

The remainder of the output from the Park City region in 1938 comprised small lots of ore from the New Quincy, Keystone, and Park Flag properties and old tailings from Silver Creek.

### TOOELE COUNTY

*Camp Floyd (Mercur) district.*—The output of gold from Mercur increased from 14,016 ounces in 1937 to 23,001 ounces in 1938, as a result of increased output by both Snyder Mines, Inc., and Geyser Marion Gold Mining Co. Snyder Mines, Inc., operated the remodeled Manning mill from January to October and treated more than 85,000 tons of ore from the Con Mercur property by combined cyanidation and flotation; in addition, the company and lessees shipped 21,150 tons of gold ore for smelting. The Con Mercur mine was the third-largest producer of gold in Utah in 1938. The mill also treated by straight cyanidation about 5,100 tons of oxidized custom ore from five properties in the district. The Geyser Marion Gold Mining Co. completed the installation of new crushing, leaching, and precipitation equipment at the Sacramento and Geyser Marion properties, increasing the capacity of the two plants to about 800 tons of ore a day. The mills handled 65,251 tons of low-grade gold ore from the Geyser Marion open-cut mine and 34,529 tons of custom ore, including 27,157 tons from the Sacramento mine; the ore was treated by straight cyanidation. Other producers in the Camp Floyd district in 1938 included the Golden Gate, Herschel, Boston Sunshine, West Dip, McCornick, Rover, and Silver Lode properties; most of the output from these mines was treated at the two custom mills, but in addition gold ore was shipped crude for smelting from the West Dip and Boston Sunshine mines.

*Clifton (Gold Hill) district.*—Crude ore was shipped for smelting in 1938 from several mines in the Gold Hill district, including the Clifton Standard, Garrison, Gold Spar, Midas, New Baltimore, Rube No. 3, and Success.

*Ophir and Rush Valley districts.*—The value of the metal output from the Stockton-Ophir region decreased more than $1,160,000 in 1938, owing to decreases at the Hidden Treasure mine and at the properties operated by the Combined Metals Reduction Co. The Hidden Treasure property near Ophir was sold during the year to the United States Smelting, Refining & Mining Co.; production was suspended in July and was not resumed until early in 1939 after completion of an extensive reconditioning and development program. The output in 1938 was 13,742 tons of zinc-lead ore shipped to Midvale for milling, a decrease from 27,702 tons in 1937. The Ophir Development Co. continued work at the Ophir Hill mine, shipping 2,112 tons of zinc-lead ore to the mill at Tooele and 218 tons of lead ore for smelting. The International Smelting & Refining Co. completed the erection of a 600-ton flotation plant at the Ophir Hill tailings dump and placed the plant in operation November 21; about 5,000 tons of tailings were treated by the end of the year, and copper-lead concen-

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trates were shipped to Tooele for smelting. Much of the equipment used in the construction of the mill was salvaged from the old Utah-Apex mill at Bingham, which was dismantled during 1938.

The Combined Metals Reduction Co. curtailed operations at the Cyclone (Bluestone), Honerine, and West Calumet mines in 1938, and the output of lead ore and zinc-lead ore was much less than in 1937; the output from the Cyclone mine decreased from about 15,000 to 8,429 tons and lead ore and zinc-lead ore from the Honerine and West Calumet mines from more than 42,000 to about 32,600 tons. The lead ore from all three properties was shipped to Tooele for smelting, and the zinc-lead ore was milled in the flotation plant at Bauer. Other producers in the Stockton-Ophir region included the Kearsarge, Lakes of Killarney, Tintic Ophir, Ophir, Zella, Mono, Commodore, Circle, and Hercules mines.

Other producing mines in Tooele County in 1938 included the Benmore property in the Columbia district; the Humdinger (Lead Ore) mine in the Free Coinage district; the Georgia Lyn, Monarch, and Lone Star mines at Lakeside; the Scranton mine in the North Tintic district; the Silver Island mine north of Wendover; the Combination mine in Pine Canyon in the West Mountain district; and the Eagle's Nest, Oro Del Rey, Liberty, Depression, and Imperial mines in the Willow Springs district.

### UTAH COUNTY

*American Fork district.*—The value of the metal output from the American Fork district decreased $91,205 in 1938, as the output from the Live Yankee mine declined. The property is owned by the American Smelting & Refining Co., and lessees' shipments of gold ore and zinc-lead ore declined from about 4,300 to 877 tons. Other producers in the American Fork district in 1938 included the Blue Rock (Pacific), Dutchman, and Bog Iron mines.

*Tintic district.*—The mines in the Utah County section of the Tintic district are reviewed under Juab County.

### WASHINGTON COUNTY

The Dixie (Apex) mine in the Tutsagubet district, operated by the Utah Southern Mining Co., was the only producer in Washington County in 1938; the company shipped 147 tons of copper ore to Garfield for smelting.

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# GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By T. H. Miller and Paul Luff

## SUMMARY OUTLINE


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The total value of the gold, silver, copper, lead, and zinc recovered from Washington ores and gravels in 1938 was $5,510,440, or more than double the value of the 1937 output ($2,253,054), and was the largest in the history of mining in the State. Substantial increases were recorded in the output of all five metals, especially gold and copper. Of outstanding interest was the starting in April of the new mill at the Holden property in Chelan County by the Howe Sound Co. The company mined and milled 371,800 tons of ore and was the largest producer of gold, silver, and copper in Washington in 1938. The output of gold from Ferry and Stevens Counties increased considerably, owing chiefly to regular operation of cyanide mills at Republic and Orient. Lead and zinc production from Pend Oreille County increased owing to a larger output of zinc-lead ore from two mines near Metaline Falls.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.



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*Mine production of gold, silver, copper, lead, and zinc in Washington, 1934–38, and total, 1860–1938, in terms of recovered metals*

| Year | Mines producing | | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Fine ounces | Value | Fine ounces | Value |
| 1934 | 62 | 210 | 47,902 | 8,301.83 | $290,149 | 44,120 | $28,522 |
| 1935 | 63 | 172 | 32,187 | 9,739.60 | 340,886 | 52,338 | 37,618 |
| 1936 | 44 | 106 | 133,435 | 12,217.40 | 427,609 | 66,900 | 51.814 |
| 1937 | 65 | 90 | 294,826 | 36,310.00 | 1,270,850 | 126,304 | 97,696 |
| 1938 | 77 | 80 | 901,689 | 74,175.00 | 2,596,125 | 380,938 | 246,263 |
| 1860–1938 | | | (1) | 1,624,993.00 | 35,630,078 | 10,013,622 | 7,095.512 |

| Year | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| 1934 | 13,900 | $1,112 | 581,298 | $21,508 | 3,852,419 | $165,654 | $506.945 |
| 1935 | 86,699 | 7,196 | 206,150 | 8,246 | 2,159 | 95 | 394,041 |
| 1936 | 204,000 | 18,768 | 1,680,000 | 77,280 | 8,806,000 | 440,300 | 1,015,771 |
| 1937 | 128,000 | 15,488 | 5,660,000 | 333,940 | 8,232,000 | 535,080 | 2,253,054 |
| 1938 | 12,034,000 | 1,179,332 | 8,568,000 | 394,128 | 22,804,000 | 1,094,592 | 5,510,440 |
| 1860–1938 | [2] 19,768 | 6,057,509 | [2] 43,100 | 5,456,646 | [2] 40,277 | 4,238,810 | 58,478,555 |

[1] 1860–1903: Figures not available; 1904–38: 3,634,402 tons produced. [2] Short tons.

*Gold and silver produced at placer mines in Washington, 1934–38, in terms of recovered metals*

| Year | Gold | | Silver | | Total value |
|---|---|---|---|---|---|
| | Fine ounces | Value | Fine ounces | Value | |
| 1934 | 1,773.45 | $61,982 | 317 | $205 | $62,187 |
| 1935 | 1,547.60 | 54,166 | 263 | 189 | 54,355 |
| 1936 | 657.20 | 23,002 | 133 | 103 | 23,105 |
| 1937 | 371.00 | 12,985 | 48 | 37 | 13,022 |
| 1938 | 1,575.00 | 55,125 | 218 | 141 | 55,266 |

*Gold.*—The output of gold in Washington increased from 36,310 fine ounces in 1937 to 74,175 ounces in 1938. Most of the gain was in Chelan County and was due to the starting of milling operations by the Howe Sound Co. The company treated 371,800 tons of gold-copper-silver ore in 1938 and was by far the largest gold producer in the State. Gold production from Ferry County increased 7,534 ounces owing to continuous operation of the Knob Hill cyanide plant and increased shipments of smelting ore from other mines at Republic. The gold output of Stevens County increased 1,763 ounces; most of it came from the First Thought cyanidation mill near Orient. Gold production from Whatcom and Okanogan Counties decreased. Gold ore treated at gold and silver mills increased to 212,161 tons in 1938, from 142,790 tons in 1937, and yielded 40 percent of the total gold produced; gold ore smelted (56,896 tons) yielded 16 percent; and copper ore concentrated (373,000 tons) yielded 41 percent. Most of the gold ore shipped for smelting came from the Aurum, Mountain Lion, Republic, and Quilp mines in the Republic district, Ferry County, but nearly 11,000 tons of low-grade gold ore from a property near Wenatchee, Chelan County, was shipped as siliceous flux to the smelter at

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Tacoma. No large placer operations were reported in Washington in 1938, but gold output from placers increased to 1,575 ounces, most of which came from operations along the Columbia River, chiefly in Stevens and Ferry Counties on ground that will later be submerged under Grand Coulee Reservoir.

*Silver.*—The output of recoverable silver in Washington in 1938 was three times that in 1937. Nearly half of the increase was from copper ore (chiefly from Chelan County), but substantial increases also came from silver ore (chiefly from the Arlington mine in Okanogan County) and from gold ore from mines at Republic. The Chelan Division of the Howe Sound Co. was the largest silver producer in Washington in 1938, followed by the Arlington mine near Okanogan and the Knob Hill, Aurum, and Quilp mines at Republic; other important producers were the Silver Queen (Ark Mines Co.) mine at Kettle Falls and the Josephine mine near Metaline Falls. Gold ore and copper ore each yielded 33 percent of the total silver produced, and silver ore yielded 29 percent; ore concentrated yielded 65 percent, ore smelted nearly 20 percent, and ore to gold and silver mills 15 percent.

*Copper.*—The output of recoverable copper in Washington in 1938 was by far the largest in the history of the State and came chiefly from the Holden mine, operated by the Chelan Division of the Howe Sound Co. Most of the small remainder of the copper produced in the State came from three mines in Okanogan and Snohomish Counties. No production was reported from the Royal mine north of Leavenworth, Chelan County. The new flotation plant of the Holden property was placed in operation in April 1938. The capacity of the mill was increased during the summer and fall, and by the end of the year the mill was treating 2,000 tons of copper-gold-silver ore a day. Copper concentrates rich in gold and silver were shipped to Tacoma for smelting.

*Lead and zinc.*—The output of recoverable lead and zinc in Washington increased markedly in 1938 owing to an increase of more than 143,000 tons in the output of zinc-lead ore from two mines near Metaline Falls. All the zinc and nearly 94 percent of the lead produced in Washington came from the properties of the Pend Oreille Mines & Metals Co. and the Metaline Mining & Leasing Co. near Metaline Falls; most of the remainder of the lead output came from properties near Northport, Stevens County.

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## MINE PRODUCTION BY COUNTIES

*Mine production of gold, silver, copper, lead, and zinc in Washington in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Ore (short tons) | Gold | | | | Silver (lode and placer) | |
|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | Fine ounces | Value |
| | | | | Fine ounces | Fine ounces | Fine ounces | Value | | |
| Asotin | | 9 | | | 107 | 107 | $3,745 | 14 | $9 |
| Benton | | 3 | | | 34 | 34 | 1,190 | 3 | 2 |
| Chelan | 2 | 3 | 382,646 | 31,525 | 9 | 31,534 | 1,103,690 | 124,590 | 80,543 |
| Clallam | | 2 | | | 9 | 9 | 315 | | |
| Douglas | | 2 | | | 36 | 36 | 1,260 | 3 | 2 |
| Ferry | 15 | 7 | 207,074 | 25,654 | 244 | 25,898 | 906,430 | 119,688 | 77,374 |
| Grant | | 3 | | | 23 | 23 | 805 | 3 | 2 |
| Grays Harbor | | 1 | | | 1 | 1 | 35 | | |
| King | 3 | | 824 | 184 | | 184 | 6,440 | 2,048 | 1,324 |
| Kittitas | 4 | 8 | 51 | 20 | 65 | 85 | 2,975 | 17 | 11 |
| Lincoln | | 3 | | | 13 | 13 | 455 | | |
| Okanogan | 23 | 10 | 9,561 | 1,110 | 128 | 1,238 | 43,330 | 85,731 | 55,422 |
| Pend Oreille | 2 | 3 | 249,184 | | 7 | 7 | 245 | 14,584 | 9,428 |
| Skamania | 1 | | 5 | 25 | | 25 | 875 | 3 | 2 |
| Snohomish | 2 | 6 | 1,143 | 11 | 28 | 39 | 1,365 | 1,123 | 726 |
| Stevens | 19 | 17 | 14,180 | 1,781 | 839 | 2,620 | 91,700 | 31,677 | 20,478 |
| Whatcom | 5 | 2 | 36,871 | 12,289 | 5 | 12,294 | 430,290 | 1,352 | 874 |
| Whitman | | 1 | | | 27 | 27 | 945 | 3 | 2 |
| Yakima | 1 | | 150 | 1 | | 1 | 35 | 99 | 64 |
| | 77 | 80 | 901,689 | 72,600 | 1,575 | 74,175 | 2,596,125 | 380,938 | 246,263 |
| Total, 1937 | 65 | 90 | 294,826 | 35,939 | 371 | 36,310 | 1,270,850 | 126,304 | 97,696 |

| County | Copper | | Lead | | Zinc | | Total value |
|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | |
| Asotin | | | | | | | $3,754 |
| Benton | | | | | | | 1,192 |
| Chelan | 11,861,000 | $1,162,378 | | | | | 2,346,611 |
| Clallam | | | | | | | 315 |
| Douglas | | | | | | | 1,262 |
| Ferry | 4,000 | 392 | 1,761 | $81 | | | 984,277 |
| Grant | | | | | | | 807 |
| Grays Harbor | | | | | | | 35 |
| King | 1,347 | 132 | 5,500 | 253 | | | 8,149 |
| Kittitas | | | | | | | 2,986 |
| Lincoln | | | | | | | 455 |
| Okanogan | 35,061 | 3,436 | 43,826 | 2,016 | | | 104,204 |
| Pend Oreille | | | 8,018,500 | 368,851 | 22,804,000 | $1,094,592 | 1,473,116 |
| Skamania | | | | | | | 877 |
| Snohomish | 114,245 | 11,196 | | | | | 13,287 |
| Stevens | 14,000 | 1,372 | 498,413 | 22,927 | | | 136,477 |
| Whatcom | | | | | | | 431,164 |
| Whitman | | | | | | | 947 |
| Yakima | 4,347 | 426 | | | | | 525 |
| | 12,034,000 | 1,179,332 | 8,568,000 | 394,128 | 22,804,000 | 1,094,592 | 5,510,440 |
| Total, 1937 | 128,000 | 15,488 | 5,660,000 | 333,940 | 8,232,000 | 535,080 | 2,253,054 |

## MINING INDUSTRY

Metal mining in Washington was more active in 1938 than in any year of its history. The total value of the output was much larger than in any previous year, and new records were established in output of gold, copper, and zinc; output of lead very nearly attained the previous record. Such gains are entirely the result of large capital expenditures during 1936, 1937, and 1938, and the most important of these is the Holden enterprise of the Howe Sound Co. which includes

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complete mining, milling, power, and transportation facilities for an operation of 2,000 tons daily capacity; other expenditures, made prior to 1938 (the first full year of operation), include new cyanide mills at Republic, Orient, and Azurite and new power and milling capacity at Metaline Falls. All the large increases in output were made at properties that have new or recently improved physical plants, and as a result of these improvements the value of the State output in 1938 was more than five times that in 1936.

### ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

*Ore sold or treated in Washington in 1938, with content in terms of recovered metals*

| Source | Mines producing | Ore | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|---|
| | | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous gold ore | 49 | 271,557 | 41,869 | 127,395 | 7,038 | 7,897 | ---------- |
| Dry and siliceous gold-silver ore | 2 | 61 | 6 | 499 | 58 | 740 | ---------- |
| Dry and siliceous silver ore | 6 | 7,229 | 73 | 110,620 | 41,783 | 58,979 | ---------- |
| | 57 | 278,847 | 41,948 | 238,514 | 48,879 | 67,616 | ---------- |
| Copper ore [1] | 5 | 373,120 | 30,650 | 124,307 | 11,983,694 | ---------- | ---------- |
| Lead ore | 13 | 538 | 2 | 3,315 | 1,427 | 481,884 | ---------- |
| Zinc-lead ore | 2 | 249,184 | ---------- | 14,584 | ---------- | 8,018,500 | 22,804,000 |
| Total, lode mines | 77 | 901,689 | 72,600 | 380,720 | 12,034,000 | 8,568,000 | 22,804,000 |
| Total, placers | 80 | ---------- | 1,575 | 218 | ---------- | ---------- | ---------- |
| | 157 | 901,689 | 74,175 | 380,938 | 12,034,000 | 8,568,000 | 22,804,000 |
| Total, 1937 | 155 | 294,826 | 36,310 | 126,304 | 128,000 | 5,660,000 | 8,232,000 |

[1] By far the greatest part of this ore is an unusual copper- [gold-silver] ore necessitating a close decision between "copper ore" and "gold ore" according to Bureau of Mines Minerals Yearbook classification.

## METALLURGIC INDUSTRY

The total output of ore in Washington in 1938 was 901,689 tons; it comprised 212,161 tons treated at gold and silver mills, 631,864 tons treated at concentration plants, and 57,664 tons shipped crude to smelters.

*Gold and silver mills.*—Seven small straight amalgamation plants treated 2,071 tons of gold ore, recovering 439 ounces of gold and 230 ounces of silver in amalgamation bullion and 58 tons of gold concentrates yielding 111 ounces of gold and 190 ounces of silver.

Three straight cyanidation plants and one combined cyanidation and corduroy-concentration plant treated 210,090 tons of ore concontaining (original or gross contents) 31,550 ounces of gold and 67,857 ounces of silver; the cyanide precipitates yielded 27,061 ounces of gold and 57,663 ounces of silver and the concentrates yielded 2,344 ounces of gold and 213 ounces of silver, indicating average over-all recoveries of 93 percent of the gold and 85 percent of the silver. Cyanidation reagents consumed at the four plants comprised 201,992 pounds of sodium cyanide (91-percent grade), 28,480 pounds of Aero Brand calcium cyanide, 41,822 pounds of zinc dust, and 1,205,082

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pounds of lime; other reagents reported included lead acetate, litharge, soda ash, and starch.

*Concentration plants.*—The 631,864 tons of ore treated at concentration plants comprised 373,000 tons of copper ore treated at three plants, 249,184 tons of zinc-lead ore at two plants, 7,180 tons of silver ore at three plants, and 2,500 tons of gold ore at four plants.

Details of the treatment of all ore produced in Washington in 1938 are given in the following tables.

*Mine production of metals in Washington in 1938, by methods of recovery, in terms of recovered metals*

| Method of recovery | Material treated | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Ore amalgamated | 2,071 | 439 | 230 | | | |
| Ore cyanided | 210,090 | 27,061 | 57,663 | | | |
| Concentrates smelted | 52,335 | 33,549 | 248,414 | 11,991,876 | 8,080,690 | 22,804,000 |
| Ore smelted | 57,664 | 11,551 | 74,413 | 42,124 | 487,310 | |
| Placer | | 1,575 | 218 | | | |
| | | 74,175 | 380,938 | 12,034,000 | 8,568,000 | 22,804,000 |
| Total, 1937 | | 36,310 | 126,304 | 128,000 | 5,660,000 | 8,232,000 |

*Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Washington in 1938, by types of mills and by counties, in terms of recovered metals*

AMALGAMATION MILLS

| County | Ore treated | Recovered in bullion | | Concentrates smelted and recovered metal | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Concentrates produced | Gold | Silver |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Short tons* | *Fine ounces* | *Fine ounces* |
| Kittitas | 46 | 19 | 3 | | | |
| Okanogan | 1,840 | 332 | 196 | 58 | 111 | 190 |
| Skamania | 5 | 25 | 3 | | | |
| Stevens | 30 | 17 | 20 | | | |
| Whatcom | 150 | 46 | 8 | | | |
| | 2,071 | 439 | 230 | 58 | 111 | 190 |
| Total, 1937 | 20,375 | 2,449 | 1,278 | 143 | 200 | 449 |

CYANIDATION MILLS

| | | | | | | |
|---|---|---|---|---|---|---|
| Ferry | 161,907 | 15,776 | 55,600 | | | |
| Stevens | 11,668 | 1,723 | 963 | | | |
| Whatcom | 36,515 | 9,562 | 1,100 | 24 | 2,344 | 213 |
| | 210,090 | 27,061 | 57,663 | 24 | 2,344 | 213 |
| Total, 1937 | 122,415 | 20,170 | 33,333 | 38 | 3,653 | 308 |
| Grand total: 1938 | 212,161 | 27,500 | 57,893 | 82 | 2,455 | 403 |
| 1937 | 142,790 | 22,619 | 34,611 | 181 | 3,853 | 757 |

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*Mine production of metals from concentrating mills in Washington in 1938, by counties, in terms of recovered metals*

| County | Ore treated | Concentrates smelted and recovered metal | | | | | |
|---|---|---|---|---|---|---|---|
| | | Concentrates produced | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Chelan | 371,800 | 25,592 | 30,635 | 122,132 | 11,861,000 | | |
| King | 800 | 114 | 176 | 1,593 | 1,241 | 4,552 | |
| Okanogan | 7,030 | 442 | 269 | 82,933 | 33,474 | 38,560 | |
| Pend Oreille | 249,184 | 25,838 | | 14,584 | | 8,018,500 | 22,804,000 |
| Snohomish | 1,050 | 175 | 9 | 1,035 | 82,990 | | |
| Stevens | 1,850 | 81 | 4 | 25,635 | 8,824 | 19,078 | |
| Yakima | 150 | 11 | 1 | 99 | 4,347 | | |
| | 631,864 | 52,253 | 31,094 | 248,011 | 11,991,876 | 8,080,690 | 22,804,000 |
| Total, 1937 | 114,566 | 11,355 | 80 | 31,556 | 103,420 | 5,282,495 | 8,232,000 |

*Gross metal content of Washington concentrates produced in 1938, by classes of concentrates*

| Class of concentrates | Concentrates produced | Gross metal content | | | | |
|---|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead | Zinc |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Dry and siliceous | 233 | 2,824 | 5,745 | 2,399 | 10,452 | |
| Copper | 26,181 | 30,712 | 205,697 | 12,350,721 | 73,596 | |
| Lead | 5,121 | 10 | 14,763 | 98 | 7,987,634 | 223,548 |
| Lead-copper | 71 | 3 | 22,209 | 10,851 | 19,310 | |
| Zinc | 20,729 | | | | 447,062 | 25,338,773 |
| | 52,335 | 33,549 | 248,414 | 12,364,069 | 8,538,054 | 25,562,321 |
| Total, 1937 | 11,536 | 3,933 | 32,313 | 106,677 | 5,561,980 | 9,257,510 |

*Mine production of metals from Washington concentrates in 1938, in terms of recovered metals*

BY COUNTIES

| | Concentrates | Gold | Silver | Copper | Lead | Zinc |
|---|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* |
| Chelan | 25,592 | 30,635 | 122,132 | 11,861,000 | | |
| King | 114 | 176 | 1,593 | 1,241 | 4,552 | |
| Okanogan | 500 | 380 | 83,123 | 33,474 | 38,560 | |
| Pend Oreille | 25,838 | | 14,584 | | 8,018,500 | 22,804,000 |
| Snohomish | 175 | 9 | 1,035 | 82,990 | | |
| Stevens | 81 | 4 | 25,635 | 8,824 | 19,078 | |
| Whatcom | 24 | 2,344 | 213 | | | |
| Yakima | 11 | 1 | 99 | 4,347 | | |
| | 52,335 | 33,549 | 248,414 | 11,991,876 | 8,080,690 | 22,804,000 |
| Total, 1937 | 11,536 | 3,933 | 32,313 | 103,420 | 5,282,495 | 8,232,000 |

BY CLASSES OF CONCENTRATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Dry and siliceous | 233 | 2,824 | 5,745 | 2,187 | 5,165 | |
| Copper | 26,181 | 30,712 | 205,697 | 11,980,930 | 36,800 | |
| Lead | 5,121 | 10 | 14,763 | 78 | 7,662,357 | |
| Lead-copper | 71 | 3 | 22,209 | 8,681 | 18,538 | |
| Zinc | 20,729 | | | | 357,830 | 22,804,000 |
| | 52,335 | 33,549 | 248,414 | 11,991,876 | 8,080,690 | 22,804,000 |

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*Gross metal content of Washington crude ore shipped to smelters in 1938, by classes of ore*

| Class of ore | Ore | Gross metal content | | | |
|---|---|---|---|---|---|
| | | Gold | Silver | Copper | Lead |
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Dry and siliceous | 57,006 | 11,544 | 70,057 | 5,603 | 7,260 |
| Copper | 120 | 5 | 1,041 | 36,438 | |
| Lead | 538 | 2 | 3,315 | 1,707 | 502,352 |
| | 57,664 | 11,551 | 74,413 | 43,748 | 509,612 |
| Total, 1937 | 37,470 | 9,387 | 59,332 | 25,529 | 394,067 |

*Mine production of metals from Washington crude ore shipped to smelters in 1938, in terms of recovered metals*

BY COUNTIES

| | Ore | Gold | Silver | Copper | Lead |
|---|---|---|---|---|---|
| | *Short tons* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* |
| Chelan | 10,846 | 890 | 2,458 | | |
| Ferry | 45,167 | 9,878 | 64,057 | 4,000 | 1,761 |
| King | 24 | 8 | 455 | 106 | 948 |
| Kittitas | 5 | 1 | | | |
| Okanogan | 691 | 398 | 2,384 | 1,587 | 5,266 |
| Snohomish | 93 | 2 | 85 | 31,255 | |
| Stevens | 632 | 37 | 4,943 | 5,176 | 479,335 |
| Whatcom | 206 | 337 | 31 | | |
| | 57,664 | 11,551 | 74,413 | 42,124 | 487,310 |
| Total, 1937 | 37,470 | 9,387 | 59,332 | 24,580 | 377,505 |

BY CLASSES OF ORE

| | | | | | |
|---|---|---|---|---|---|
| Dry and siliceous | 57,006 | 11,544 | 70,057 | 5,340 | 5,426 |
| Copper | 120 | 5 | 1,041 | 35,357 | |
| Lead | 538 | 2 | 3,315 | 1,427 | 481,884 |
| | 57,664 | 11,551 | 74,413 | 42,124 | 487,310 |

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## REVIEW BY COUNTIES AND DISTRICTS

*Mine production of gold, silver, copper, lead, and zinc in Washington in 1938, by counties and districts, in terms of recovered metals*

| County and district | Mine producing | | Ore | Gold | | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Asotin County: Snake River | | 9 | | | 107 | 107 | 14 | | | | $3,754 |
| Benton County: Columbia River | | 3 | | | 34 | 34 | 3 | | | | 1,192 |
| Chelan County: | | | | | | | | | | | |
| Chelan | 1 | | 371,800 | 30,635 | | 30,635 | 122,132 | 11,861,000 | | | 2,313,557 |
| Wenatchee | 1 | 3 | 10,846 | 890 | 9 | 899 | 2,458 | | | | 33,054 |
| Clallam County: Ozette | | 2 | | | 9 | 9 | | | | | 315 |
| Douglas County: Columbia River | | 2 | | | 36 | 36 | 3 | | | | 1,262 |
| Ferry County: | | | | | | | | | | | |
| Columbia River | | 5 | | | 241 | 241 | 31 | | | | 8,455 |
| Danville | 1 | | 155 | 65 | | 65 | 82 | 4,000 | | | 2,720 |
| Enterprise | 1 | | 4 | | | | 181 | | 1,761 | | 198 |
| Republic | 13 | 2 | 206,915 | 25,589 | 3 | 25,592 | 119,394 | | | | 972,904 |
| Grant County: Columbia River | | 3 | | | 23 | 23 | 3 | | | | 807 |
| Grays Harbor County: Pacific Beach | | 1 | | | 1 | 1 | | | | | 35 |
| King County: Miller River | 3 | | 824 | 184 | | 184 | 2,048 | 1,347 | 5,500 | | 8,149 |
| Kittitas County: Swauk | 4 | 8 | 51 | 20 | 65 | 85 | 17 | | | | 2,986 |
| Lincoln County: Columbia River | | 3 | | | 13 | 13 | | | | | 455 |
| Okanogan County: | | | | | | | | | | | |
| Cascade | 3 | | 1,696 | 517 | | 517 | 628 | 51 | 913 | | 18,548 |
| Columbia River | | 4 | | | 62 | 62 | 14 | | | | 2,179 |
| Conconully | 2 | | 17 | | | | 775 | 704 | 3,000 | | 708 |
| Methow | 5 | | 1,570 | 230 | | 230 | 399 | 1,296 | 174 | | 8,443 |
| Myers Creek and Mary Ann Creek | 5 | 1 | 286 | 159 | 3 | 162 | 198 | 10 | 826 | | 5,837 |
| Palmer Mountain | 8 | | 5,992 | 204 | | 204 | 83,703 | 33,000 | 38,913 | | 66,275 |
| Similkameen River | | 5 | | | 63 | 63 | 14 | | | | 2,214 |
| Pend Oreille County: Metaline | 2 | 3 | 249,184 | | 7 | 7 | 14,584 | | 8,018,500 | 22,804,000 | 1,473,116 |
| Skamania County: Niggerhead | 1 | | 5 | 25 | | 25 | 3 | | | | 877 |
| Snohomish County: | | | | | | | | | | | |
| Index | 1 | | 1,050 | 9 | | 9 | 1,035 | 82,990 | | | 9,117 |
| Sultan | 1 | 6 | 93 | 2 | 28 | 30 | 88 | 31,255 | | | 4,170 |
| Stevens County: | | | | | | | | | | | |
| Bossburg | 2 | | 18 | | | | 362 | | 4,826 | | 456 |
| Chewelah | 1 | | 27 | 3 | | 3 | 956 | 4,102 | | | 1,125 |
| Columbia River | | 17 | | | 839 | 839 | 116 | | | | 29,440 |
| Colville | 2 | | 46 | 4 | | 4 | 1,321 | 143 | 4,413 | | 1,211 |
| Kettle Falls | 4 | | 1,725 | 18 | | 18 | 22,275 | 8,755 | 18,826 | | 16,754 |

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*Mine production of gold, silver, copper, lead, and zinc in Washington in 1938, by counties and districts, in terms of recovered metals*—Continued

| County and district | Mine producing | | Ore | Gold | | | Silver (lode and placer) | Copper | Lead | Zinc | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | | | | | |
| Stevens County—Continued. | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Pounds* | *Pounds* | *Pounds* | |
| Northport | 5 | | 483 | | | | 2,076 | 857 | 467,261 | | $22,920 |
| Orient | 3 | | 11,718 | 1,755 | | 1,755 | 1,007 | | | | 62,076 |
| Springdale | 2 | | 163 | 1 | | 1 | 3,564 | 143 | 3,087 | | 2,495 |
| Whatcom County: | | | | | | | | | | | |
| Mount Baker | 2 | 2 | 53 | 33 | 5 | 38 | 17 | | | | 1,341 |
| Slate Creek | 3 | | 36,818 | 12,256 | | 12,256 | 1,335 | | | | 429,823 |
| Whitman County: Snake River | | 1 | | | 27 | 27 | 3 | | | | 947 |
| Yakima County: Bumping Lake | 1 | | 150 | 1 | | 1 | 99 | 4,347 | | | 525 |
| Total Washington | 77 | 80 | 901,689 | 72,600 | 1,575 | 74,175 | 380,938 | 12,034,000 | 8,568,000 | 22,804,000 | 5,510,440 |

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### ASOTIN COUNTY

The entire output of gold and silver from Asotin County in 1938 came from placer operations along the Snake River near Asotin and Clarkston; the output increased considerably owing to the operation of a small dragline and washer near Clarkston.

### BENTON COUNTY

Three placers on the Columbia River near Paterson and Richland were active in 1938. Most of the output came from the mechanical washing plant of the Gone Busted placer on Blalock Island near Paterson.

### CHELAN COUNTY

*Chelan district.*—The Holden mine, high in the Cascade Mountains about 54 miles northwest of Chelan, has long been known as a potential producer of copper, gold, and silver, but inadequate transportation and power facilities greatly retarded development. The property was acquired by the Howe Sound Co. in 1930, and the Chelan Division of the company was formed to operate it. After an extensive period of exploration and mine development, actual construction of the mining and milling plants was started in 1937. The new plant, with an initial capacity of 1,000 tons a day, was placed in operation April 1, 1938. Supplementary construction included a 53-mile electric transmission line, docks, roads, miscellaneous camp buildings, etc. During the summer and fall of 1938 the mill was enlarged, and by the end of the year it was treating 2,000 tons of ore daily by flotation concentration. The concentrates are hauled by truck to Lucerne, a landing on Chelan Lake, and thence by barge to Chelan and by rail to Tacoma for smelting. The gold content of the concentrates produced is unusually high for copper ores and is nearly as valuable as the copper content; considerable silver also is recovered. During 1938 the company milled 371,800 tons of ore and was by far the most important mining operation in the State; the mine ranked first in output of gold, silver, and copper. Nearly 16,000 feet of mine development was done during 1938, and employment was provided for an average of 413 men.

The American Smelting & Refining Co. operated a property near Wenatchee during the last quarter of 1938 and shipped nearly 11,000 tons of highly siliceous low-grade gold ore to the smelter at Tacoma. The material is used as siliceous flux in the copper-smelting operations, replacing barren siliceous material (beach sands) in the furnace charges.

### FERRY COUNTY

*Republic district.*—Mines in the Republic district produced gold and silver valued at $972,904 in 1938 compared with $698,693 in 1937. Knob Hill Mines, Inc., was again the largest producer at Republic; the company operated the new 400-ton cyanide plant the entire year, treating 147,514 tons of ore from the Knob Hill property and 4,565 tons of old tailings from the Mountain Lion property, which was acquired during the year. No crude ore was shipped from the Knob Hill, but about 8,300 tons of smelting ore were shipped from the Mountain Lion. The Eureka Mining & Milling Co. continued

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operation of both the Quilp and Republic groups; the cyanide mill treated 9,828 tons of Quilp ore during the first 5 months of the year, but the plant was closed and dismantled after June 1; shipments of crude ore to smelters continued throughout the year from both the Quilp and Republic mines. Lessees continued shipments of gold ore of smelting grade from various properties of the Aurum Mining Co. during 1938; the company resumed development late in the year, and a mill was reported under consideration for the Last Chance group. The remainder of the district lode production was siliceous ore shipped for smelting from several properties, including the California, El Caliph, Golden Harvest, Morning Glory, Opal, and Seattle mines. The ore of smelting grade was shipped to Tacoma, Wash., and Trail, British Columbia.

The remainder of the output from Ferry County comprised gold ore shipped for smelting by the Morning Star Mining Co. at Danville; lead ore from the Lucky Boy mine near Inchelium; and placer dust and retorts from operations along the Columbia River and at Republic, chiefly from the Plumb Bar near Keller.

### KING COUNTY

Apex Gold Mines, Inc., started milling operations at its property in the Miller River district in 1938; several hundred tons of gold ore were treated in the 75-ton flotation plant, and gold concentrates were shipped to Tacoma. Siliceous ore was shipped for smelting from the Coney Basin and Cleopatra & Aces Up properties, also in the Miller River district.

### KITTITAS COUNTY

Small lots of placer dust were marketed in 1938 from several properties on Swauk Creek, chiefly from the Sunny Bar property; producing lode mines included the Mountain Daisy, Wall Street, and Ione Fraction.

### OKANOGAN COUNTY

Suspension of operations by the Northern Gold Corporation at the Bodie mine near Wauconda (Cascade district) early in 1938 resulted in a sharp decrease in gold production from Okanogan County. An increase was recorded at the Arlington property in the Palmer Mountain district, as Arlington Mines, Inc., remodeled the flotation plant and milled 5,330 tons of silver ore; concentrates rich in copper and silver were shipped to Tacoma. Other producing lode mines in Okanogan County in 1938 included the Whitestone and Golconda mines in the Cascade district; the Chief Sunshine and Seven Devils mines near Conconully; the Mazama Queen and Red Shirt mines in the Methow district; the Mother Lode, Overtop, Gray Eagle, and Peterson mines in the Myers Creek and Mary Ann Creek district; and the Hiawatha, John Judge, Triune, American Rand, and Owasco mines in the Palmer Mountain district. Placer production was reported from properties along the Columbia and Similkameen Rivers and from Myers Creek and Mary Ann Creek.

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### PEND OREILLE COUNTY

*Metaline district.*—The Pend Oreille Mines & Metals Co. operated its mine and 600-ton flotation plant near Metaline Falls continuously during 1938 and treated 214,120 tons of zinc-lead ore, the greatest output in the history of the company; the flotation plant was enlarged during 1937 and operated at capacity during 1938. The Metaline Mining & Leasing Co. operated its mine for 5 months (January, February, March, November, and December) in 1938 and treated 35,064 tons of zinc-lead ore in the 300-ton flotation plant. The products (lead concentrates and zinc concentrates) of the two mills were shipped to reduction plants outside the State for treatment. The combined output of the two mines was the largest in the history of Pend Oreille County and established a new record zinc output for the State.

### SNOHOMISH COUNTY

Copper ore was produced in 1938 at the Sunset mine in the Index district and the Florence Rae mine in the Sultan district. Placer dust was recovered at several properties along the Sultan River.

### STEVENS COUNTY

The First Thought Mine Corporation operated the 50-ton cyanidation plant near Orient throughout 1938 and treated 11,668 tons of gold ore, an increase from 4,683 tons in 1937; cyanide bullion yielding 1,723 ounces of gold and 963 ounces of silver was marketed. The Ark Mines Co. operated the Silver Queen property near Kettle Falls and treated about 1,700 tons of silver ore by flotation, shipping lead-copper concentrates to Kellogg, Idaho, for smelting. Other producing lode mines in Stevens County included the Young America and Silver Trail mines near Bossburg; the Copper King mine at Chewelah; the Old Dominion and Middleport mines at Colville; the Electric Point, Red Top, Melrose, and Burrus mines in the Northport district; the McNally mine at Orient; and the Queen Seal and Cleveland mines near Springdale. Placer operations along the Columbia River in Stevens County accounted for the bulk of the State placer output; most of it came from the Collins, Grover, Gibson, and B & W properties. Much of the placer ground on the Columbia River in Stevens and Ferry Counties ultimately will be submerged by the reservoir created by Grand Coulee Dam.

The General Electric Co. operated the Germania mine near Springdale the entire year and treated 28,641 tons of tungsten ore in the 100-ton concentration plant. A little molybdenum ore was produced at the Monitor mine east of Fruitland by the Deertrail Monitor Mines Co.

### WHATCOM COUNTY

The American Smelting & Refining Co. continued regular operations at the Azurite mine in the Slate Creek district during 1938 and treated 36,515 tons of gold ore in the 100-ton cyanidation and corduroy-table concentration mill; cyanide bullion yielded 9,562 ounces of gold and 1,100 ounces of silver, and 24 tons of concentrates yielded 2,344 ounces of gold and 213 ounces of silver. The Boundary Red Mountain mine in the Mount Baker district was not operated in 1938, but a little mill

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clean-up material was amalgamated. Gold ore from the New Light mine was also amalgamated, and gold ore was shipped for smelting from the Gold Run and Allen Basin mines.

### YAKIMA COUNTY

The Copper Mining Co. treated 150 tons of copper ore in a small concentrator and shipped 11 tons of copper concentrates for smelting; the company also produced a small quantity of tungsten concentrates.

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# GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By CHAS. W. HENDERSON AND A. J. MARTIN

## SUMMARY OUTLINE


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The annual gold production of Wyoming dropped below 1,000 ounces in 1938 for the first time since the dragline dry-land dredge method of mining placer deposits was introduced in the State in 1933. In that year and in each succeeding year through 1938 placers worked by this method have yielded most of the State gold. The only silver produced in Wyoming in 1938 that was not a byproduct of gold mining was 34 ounces contained in silver ore shipped from the Sunlight district, Park County. The Atlantic City district, Fremont County, continued to be the principal gold-producing district of the State. No recoverable copper or lead has been produced in Wyoming since 1935.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

*Prices of gold, silver, copper, lead, and zinc, 1934–38*

| Year | Gold [1] | Silver [2] | Copper [3] | Lead [3] | Zinc [3] |
|---|---|---|---|---|---|
| | *Per fine ounce* | *Per fine ounce* | *Per pound* | *Per pound* | *Per pound* |
| 1934 | $34.95 | [4] $0.646+ | $0.080 | $0.037 | $0.043 |
| 1935 | 35.00 | .71875 | .083 | .040 | .044 |
| 1936 | 35.00 | .7745 | .092 | .046 | .050 |
| 1937 | 35.00 | .7735 | .121 | .059 | .065 |
| 1938 | 35.00 | [4] .646+ | .098 | .046 | .048 |

[1] 1934: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

[3] Yearly average weighted price of all grades of primary metal sold by producers.

[4] $0.64646464.

The following table shows the annual output of ore from lode mines producing gold, silver, copper, and lead and the quantity and value of the metals recovered from both lode and placer mines in Wyoming from 1934 to 1938; it also gives the total metal production from 1867 to 1938. About three-fourths of the total recorded value of the four metals is in copper, most of which was mined before 1924 in the Encampment district in Carbon County and the Hartville district in Laramie County.



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*Mine production of gold, silver, copper, and lead in Wyoming, 1934–38, and total, 1867–1938, in terms of recovered metals*

| Year | Ore (short tons) | Gold (lode and placer) | | Silver (lode and placer) | | Copper | | Lead | | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Fine ounces | Value | Fine ounces | Value | Pounds | Value | Pounds | Value | |
| 1934 | 8,173 | 4,871.36 | $170,254 | 710 | $459 | 3,500 | $280 | 2,000 | $74 | $171,067 |
| 1935 | 4,190 | 3,715.00 | 130,025 | 1,152 | 828 | 1,000 | 83 | 5,000 | 200 | 131,136 |
| 1936 | 344 | 1,964.40 | 68,754 | 1,113 | 862 | | | | | 69,616 |
| 1937 | 17 | 1,776.00 | 62,160 | 203 | 157 | | | | | 62,317 |
| 1938 | 581 | 798.00 | 27,930 | 328 | 212 | | | | | 28,142 |
| 1867–1938 | (1) | 76,090.00 | 1,771,478 | 74,297 | 51,516 | [2]16,319 | 5,682,652 | [2]8 | 568 | 7,506,214 |

[1] Figures not available.
[2] Short tons.

## MINE PRODUCTION BY COUNTIES

*Mine production of gold and silver in Wyoming in 1938, by counties, in terms of recovered metals*

| County | Mines producing | | Ore sold or treated | Gold | | | Silver | | | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lode | Placer | | Lode | Placer | Total | Lode | Placer | Total | |
| | | | *Short tons* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | *Fine ounces* | |
| Albany | | 3 | | | 42.20 | 42.20 | | 5 | 5 | $1,480 |
| Carbon | 1 | 3 | 30 | 19.40 | 11.60 | 31.00 | 6 | 1 | 7 | 1,090 |
| Fremont | 6 | 18 | 550 | 174.20 | 546.40 | 720.60 | 209 | 73 | 282 | 25,403 |
| Park | 1 | | 1 | | | | 34 | | 34 | 22 |
| Sheridan | | 1 | | | 1.60 | 1.60 | | | | 56 |
| Teton | | 1 | | | 2.60 | 2.60 | | | | 91 |
| | 8 | 26 | 581 | 193.60 | 604.40 | 798.00 | 249 | 79 | 328 | 28,142 |
| Total, 1937 | 3 | 27 | 17 | 164.60 | 1,611.40 | 1,776.00 | 13 | 190 | 203 | 62,317 |

## REVIEW BY COUNTIES AND DISTRICTS

### ALBANY COUNTY

*Douglas Creek district (Holmes, Keystone).*—The Clark's Fork Co. moved its dragline and dry-land dredge from Clark Fork, Park County, to placer ground on Douglas Creek 3 miles from Holmes, Albany County, and operated them from August 15 to November 1, 1938. Individuals sluicing on streams near Holmes recovered small quantities of gold.

### CARBON COUNTY

*Encampment or Upper Platte district.*—A car of gold ore was shipped from the Golden Clover property to the Garfield (Utah) smelter in June 1938.

*Spring Creek district.*—The Saratoga Mining Co. installed machinery for placer mining on the Phillips placer on North Spring Creek and operated for a period in 1938. Small-scale placering was done by individuals on Spring and Savery Creeks.

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### FREMONT COUNTY

*Atlantic City district.*—The E. T. Fisher Co. moved its dragline excavator and portable traction screening and sluicing plant from the property of the Timba-Bah Mining Co. on Rock Creek, where it had operated since 1933, to new ground comprising the Lemley and other placers farther up Rock Creek northwest of Atlantic City, where operations were carried on after June 1, 1938. Although its output of gold decreased from 1,415 fine ounces in 1937 to 406 ounces in 1938, the company continued to be the principal producer of gold in the State. A dragline and washing plant operated on the Bonanza placer in Meadow Gulch from October 9 to October 31, 1938, recovered 45.86 crude ounces of placer gold averaging 0.910 fine in gold and 0.089 fine in silver. A lessee on placers in Strawberry and Poorman Gulches used a concentrating table and sluices to treat his gravel, and other placer miners in the Atlantic City district used hand sluices and pans.

Dump material from the Iron Duke property at Lewiston was trucked to the Gold Dollar mill of the Miners Delight Consolidated Mines Co. and treated by amalgamation. The B & H Gold Mining Co. shipped 147 tons of ore containing 96.09 ounces of gold and 197 ounces of silver from the Little Ellen No. 3 mine to smelters in Utah. The mine is opened by a vertical shaft 105 feet deep and 250 feet of drifts. The Christiana claim was under development by the Carya Mining & Development Co. from about March 15 to May 15, 1938. The underground workings completed when work was suspended because of lack of capital for development comprised a 100-foot shaft, a 160-foot tunnel, and a 200-foot raise. The company erected a 20-ton amalgamation-gravity concentration mill and made a test run that yielded gold-silver bullion containing 6.53 fine ounces of gold and 6 fine ounces of silver. Sample lots of ore shipped from two other properties and a clean-up of stamp battery boxes at the Carissa mine yielded some gold and silver.

*Granite Mountains district.*—The Emigrant Mining Co. did retimbering, shaft straightening, and 33 feet of development work from July to November 2, 1938, at the Red Boy property in sec. 36, T. 31 N., R. 93 W., sixth principal meridian.

### PARK COUNTY

*Sunlight district.*—Four partners drove 20 feet of crosscut and 40 feet of drift on the Tip Top claim at the head of Galena Creek 18 miles southwest of Painter in 1938. They shipped 0.848 ton of ore assaying 0.01 ounce of gold and 39.90 ounces of silver to the ton, 0.7 percent copper, and 2.3 percent lead to the Bunker Hill smelter at Kellogg, Idaho.

### SHERIDAN COUNTY

A placer miner sluicing on Rooster Creek in the Little Big Horn River area in northwestern Sheridan County recovered dust 0.961 fine in gold and 0.035 fine in silver in 1938.

### TETON COUNTY

Frank J. Allen worked his Sterling placer, comprising three claims on Pacific Creek northeast of Moran, with a sluice box from July 1 to October 30, 1938, and produced 2.87 ounces of placer gold 0.917 fine.

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# SECONDARY METALS—NONFERROUS

By J. P. Dunlop [1]

## SUMMARY OUTLINE


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The total value of certain nonferrous metals, for which the quantity recovered from secondary sources is reported to the Bureau of Mines, was $137,915,800 in 1938—$101,215,000 less than in 1937; the total quantity decreased 299,810 short tons. The decline in total value was due partly to lower average prices for copper, zinc, tin, and lead, but the recovery of secondary copper, zinc, tin, aluminum, antimony, lead, and nickel all decreased.

*Secondary metals of certain classes recovered in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Copper, including that in alloys other than brass | 387,600 | $93,799,200 | 252,700 | $49,529,200 |
| Brass scrap re-treated | 206,400 | 41,677,000 | 153,100 | 24,668,400 |
| Lead as metal | 154,500 | 32,461,800 | 119,400 | 20,690,800 |
| Lead in alloys | 120,600 | | 105,500 | |
| Zinc as metal | [1] 64,540 | [1] 9,839,700 | 42,270 | 4,672,300 |
| Zinc in alloys other than brass | 11,150 | | 6,400 | |
| Tin as metal | 8,270 | 32,124,100 | 4,900 | 19,284,600 |
| Tin in alloys and chemical compounds | 22,030 | | 18,710 | |
| Aluminum as metal | 29,360 | 23,773,000 | 16,700 | 15,326,000 |
| Aluminum in alloys | 33,200 | | 22,100 | |
| Antimony as metal and in alloys | 12,340 | 3,776,000 | 8,500 | 2,099,500 |
| Nickel as metal | 917 | 1,680,000 | 850 | 1,645,000 |
| Nickel in nonferrous alloys and salts | 1,483 | | 1,450 | |
| | [1] 1,052,390 | [1] 239,130,800 | 752,580 | 137,915,800 |

[1] Revised figures.

*Scope of report.*—"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses and are so called to distinguish them from metals derived directly from ores, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or waste material vary in purity and in adaptability to use in making certain products. The figures supplied by producers cover seven metals—secondary copper, lead, zinc, tin, aluminum, antimony,

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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and nickel—and supplement those in the various chapters of this volume on the primary metals. They are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential complement to the figures in the general reports on the primary metals and will become even more valuable in future.

The variety of waste material (especially metallic waste), its utilization, and much information on its collection and disposal appear in reports of this series for preceding years. These reports name the various trade papers that handle data on secondary metals and refer to many articles relating to secondary metals recovered.

Several papers[2] presented at the 1939 annual meeting of the National Association of Waste Material Dealers, Inc., dealt with the problems and needs of metal dealers and brokers in the scrap-metal industry.

## SECONDARY METALS RECOVERED

The quantity of metals contained in numerous alloys made partly or wholly from secondary material cannot be ascertained definitely. The figures in the following tables and text, which are based upon results of the annual canvass, are approximate but constitute the only data available on an industry of growing importance.

Mints and refineries reported the recovery of 870,881 fine ounces of gold and 18,438,847 fine ounces of silver from waste or discarded material in 1938 compared with 1,040,227 ounces of gold and 23,564,986 ounces of silver in 1937. Jewelry and dental waste furnish the largest quantity of secondary gold[3] and silverware and photographic waste the largest quantity of secondary silver. Considerable gold and silver are recovered from plating solutions.[4]

No statistics collected by the Bureau of Mines show the quantity and value of old rails, pipe, machinery, and other equipment renovated for original use. Data issued by newspapers and trade publications indicate that an enormous quantity of such material is salvaged and reused. Scrap-metal collectors and dealers dispose of much of their stock to others than smelters and refineries. Foundries buy considerable quantities of good-grade copper, aluminum clippings, and tin clippings. Other customers purchase pipe, rails, stoves, radiators, boilers, and similar materials too valuable and salable to go to the melting pot.

In 1938 the price of heavy copper scrap ranged from 6.125 to 9.25 cents a pound, No. 1 composition scrap from 4.625 to 7.875 cents a pound, old zinc scrap from 1.88 to 3 cents a pound, cast-aluminum scrap from 4.625 to 9.375 cents a pound, and heavy lead scrap from 2.875 to 4.25 cents a pound.[5] This range of scrap-metal prices in 1938 was generally below that in 1937, and the quantities collected and sold were very much less, so that profits to dealers and smelters de-

[2] Earle, James S., Economic Aspects of Secondary Metals: Waste Trade Jour., Apr. 1, 1939, pp. 49, 51, 55, 57, 58.
Haskins, Charles M., Future of Waste Trade Industry: Waste Trade Jour., Apr. 1, 1939, pp. 39, 41–42.
Putney, R. A., Dealer and Refiner Have a Very Close Relationship in Scrap Metal Business: Waste Trade Jour., Apr. 1, 1939, pp. 53–54.
Skolnik, H. A., To Good Shippers Belong the Best Returns: Waste Trade Jour., Apr. 1, 1939, p. 105.
Wright, Thomas A., The Value of Scrap-Metal Analysis: Waste Trade Jour., Apr. 1, 1939, pp. 79, 81.
[3] Hoke, C. M., The Recovery of Silver, Gold, and Mercury from Precious Metal Amalgams: Metal Ind., January 1938, pp. 22–23.
[4] Savage, Frank K., Recovery of Gold and Silver from Plating Solutions: Metal Ind., April 1939, p. 160.
[5] The average daily and weekly quotations for many scrap metals and alloys can be found in the Waste Trade Journal, Waste Trade Review, Metal Industry, and American Metal Market.

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creased. Prices were only fairly good in the first quarter, but there was a steady drop until the year's lows were reached in May and June. Prices then rose until they reached the high point of the year in October, then tapered off slightly. The last half of 1938 pulled the industry out of the doldrums and made the outlook for 1939 promising as to expanded business, with not much change in opening prices.

The sharp decline in the output of motorcars and in other metal-consuming industries in 1938 cut the quantity of new scrap as much as 25 to 35 percent for some metals and alloys. Die-casting and zincking fell off so that very much less zinc dross and skimmings were available for redistillation. Notwithstanding the lower prices, most of the urban scrap was shipped promptly; but the collections of old brass, batteries, and aluminum in rural districts were much less than in 1937, and shipments to secondary smelters and foundries lagged. There was little change in the number of secondary smelters. Only a few became insolvent, and few new plants were operated. The decline in the quantity of scrap and drosses treated was especially notable at some of the largest plants, for scrap dealers and brokers were not especially anxious to turn loose material bought at low prices.

Regular primary smelters treated 5,186 tons less lead scrap and 64,064 tons less copper scrap in 1938 than in 1937. The quantity of tin-plate scrap treated decreased about 15 percent. Secondary smelters handled much less brass and aluminum and alloys containing zinc and tin, secondary brass decreasing more than 53,000 tons.

A paper by James S. Earle, of the Bureau of Mines, was read at the meeting of the National Association of Waste Material Dealers. It is impossible, for lack of space, to reproduce all the article, but the following excerpts state some pertinent facts.

*Secondary metal industry enjoys rapid growth.*—Considering the enormous size and rapid growth of this reservoir of potential scrap it is not surprising that the secondary metal industry has enjoyed a phenominal advance. Because this reservoir is so broadly distributed throughout the country, your industry serves virtually every village and hamlet in the nation. There can be no doubt that as time goes on the reworking of scrap from this source will increase in importance, as undoubtedly the upward trend in the use of metals will continue for many years to come.

Another important source of raw material for the secondary metal industry is the metal scrap derived as a byproduct from manufacturing operations. This too has increased greatly in volume with the tremendous rise in industrial activity since the beginning of the century. Much of this type of scrap, however, bypasses the secondary metal trade owing to the fact that manufacturers are improving their facilities for treating their own scrap and to the growing tendency of producers of sheets, bars, and rods to take back scrap direct from their customers. Nevertheless, a substantial amount of this byproduct metal enters the scrap trade, although in comparison with metal reclaimed from use it is less important as a source of supply. The present state of development of the secondary metal industry, with its widespread activity, is thus due largely to the scrap available in the large stocks of metal in use in all parts of the country.

Before considering the various factors that control the flow of scrap from these major sources it will be helpful to define various economic classifications of scrap. Metal returning from the store of metal in use may be referred to as "old scrap" in contrast to the byproduct of industry designated "new scrap." Old scrap may be derived from capital goods, such as buildings and industrial machinery and equipment, or from consumer goods, such as automobiles, radios and cooking utensils. In general it may be stated that there is a larger reclamation of the metal consumed in capital goods than in consumer goods. It will be observed that the essential difference between old and new scrap is that the former represents metal that has been in use and is now returning because of obsolescence, whereas new scrap is essentially metal that has not yet reached the stage of final use. New

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scrap is not as widespread in origin as old scrap, as it is found only in industrial areas; old scrap is to be found wherever human beings exist.

*Reclamation of old metals.*—From the standpoint of the scrap metal dealer or refiner, it makes little difference whether the material he trades or uses is old or new scrap, but from the standpoint of conservation there is a significant difference. New scrap is merely refined metal in one stage of manufacture and the volume available at any given time depends on the rate of industrial production. It may be described as metal on the way to an ultimate use, and its flow occurs more or less automatically as an integral part of the manufacturing process. Old scrap, on the other hand, has reached the stage of ultimate use and, having served its purpose for whatever application it was designed, is now being reclaimed for another cycle of manufacture and use. As such, it relieves the necessity of extracting an equivalent amount of metal from the mines and thus prolongs the life of our limited metalliferous ore reserves. The services performed by your industry in collecting objects discarded by the population and returning them to use is perhaps the most real contribution to conservation actually being accomplished today.

From the viewpoint of the consumer, scrap may be classified further according to origin or ownership. "Plant scrap" or "home scrap" refers to material that originates in the same plant in which it is reworked. This type consists largely of new scrap resulting from current manufacturing operations, but occasionally some old scrap obtained from dismantling obsolete plant and equipment may be included. "Purchased scrap," as its name implies, is material that the consumer obtains from other sources. All scrap supplied by waste-material dealers would be designated as purchased scrap by the consumer. It contains both old and new scrap. It will be observed that plant scrap passes through the cycle from production to recovery without change of ownership whereas in the case of purchased scrap one or more changes in title may be involved.

*Industry sensitive to changes.*—The secondary metal industry in general is subject to the same economic factors that influence other productive enterprises. When industrial activity is at a high level prices are generally remunerative, and the volume of trade in scrap is quite satisfactory. Since new scrap is merely a by-product of current manufacturing operations, trade in this material naturally rises and falls with industrial activity. By and large, new scrap moves irrespective of price levels because, as a rule, manufacturers do not care to speculate on their scrap and many of them have very limited facilities for storing large quantities. Since the money return from scrap is a relatively small part of their total business, they prefer to keep the material moving away from their plants. At times of high prices, the incentive for collecting old scrap is greater and consequently at periods of high industrial activity there is a greater return of this material. Occasionally, however, the quantity of old scrap resulting from the demolition of capital goods may be higher in periods of low industrial activity because of the necessity for curtailing productive activities and the desire to maintain employees by providing other types of work such as dismantling obsolete plants.

The limits of scrap supply at any given time are determined by the cost of delivery to the consumer and by prices. When prices are down, the flow diminishes, and if prices are low enough, the movement ceases almost entirely because the material is not worth transporting to markets. The trade in scrap is greatly influenced by freight rates, the volume of industrial activity, the rate at which obsolescence and abandonment takes place, and stocks on hand at dealers yards and consumers plants. Some of these factors are amenable to precise evaluation but others, including some of great significance to the scrap metal trade, are little understood primarily because of a lack of basic statistical data.

*Scrap's effect on metal prices.*—The effect of scrap on metal prices appears to be a field requiring more study. When business is good, price levels for scrap appear to be determined by the supply and demand for virgin metals. But when prices reach unreasonably high levels unexpected supplies of scrap deluge the market and break prices. This has happened on more than one occasion. Likewise, when consumption is at a low level, scrap exerts a depressing effect, as was demonstrated in copper during the depression. Within the last few months we have witnessed the paradoxical situation of electrolytic copper selling on the open market at a considerable discount from the so-called official producers price, an event attributed largely to the influence of scrap.

The classification and sorting of scrap metal are tremendously important factors and ones in which there is room for improvement. Owing to the marked advance in the use of alloys the modern junk pile is a very complex affair. Proper classification of scrap not only pays dividends to the collector but from the national

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point of view permits better recovery of many valuable alloying elements now going to waste. Development of more simple and inexpensive methods of classification would be a distinct benefit to all concerned.

In the foregoing remarks an attempt has been made to outline briefly the fundamental soundness of the secondary metal industry and to point out some of the factors influencing the flow of scrap. We have seen that there is need for a broader understanding of the basic economics of this industry. We have seen, also, that the reservoir of metal in use is a national asset equivalent to the crude metallic minerals contained in the earth's crust. It is not surprising, therefore, that the Government agencies chiefly concerned with the conservation of mineral raw materials have been interested in the recovery of secondary metals for many years.

*Secondary copper and brass.*—Copper produced in 1938 by smelters that handle scrap metals and drosses exclusively included 99,858 tons of pig copper (part of which was electrolytically refined), 107,100 tons of copper in remelted brass, and 60,300 tons in alloys other than brass. These figures indicate decreases of 29,136 tons of pig copper, 37,400 tons of copper in brass, and 41,700 tons in copper alloys other than brass. Regular copper smelters produced 64,064 tons less secondary copper in 1938 than in 1937.

The total value of secondary copper as metal and in brass and other alloys computed at 9.8 cents a pound (the average price in 1938 of all merchantable grades of new metal) was $70,520,800, about $58,247,400 less than in 1937.

Scrap-copper exports increased 897 tons and scrap-brass exports decreased 2,563 tons in 1938 compared with 1937.

*Secondary copper recovered in the United States, 1937–38, and imports and exports of brass and copper scrap, in short tons*

| | 1937 | 1938 | | 1937 | 1938 |
|---|---|---|---|---|---|
| Copper as metal | [1] 285,600 | [1] 192,400 | Total secondary copper (including copper content of brass scrap): | | |
| Copper in alloys other than brass | 102,000 | 60,300 | From new scrap | 123,200 | 92,500 |
| | 387,600 | 252,700 | From old scrap | 408,900 | 267,300 |
| Copper from new scrap (not including brass) | 61,600 | 40,000 | | 532,100 | 359,800 |
| Copper from old scrap (not including brass) | 326,000 | 212,700 | As metal | 285,600 | 192,400 |
| | 387,600 | 252,700 | In brass and other alloys | 246,500 | 167,400 |
| | | | | 532,100 | 359,800 |
| Brass scrap remelted: | | | Brass scrap imported | [2] | |
| New clean scrap | 88,000 | 75,000 | Scrap copper imported | 41 | [3] |
| Old scrap | 118,400 | 78,100 | Brass scrap exported | 18,551 | 15,988 |
| | 206,400 | 153,100 | Scrap copper exported | 20,914 | 21,811 |
| Copper content of brass scrap (averaging 70 percent copper): | | | | | |
| New scrap | 61,600 | 52,500 | | | |
| Old scrap | 82,900 | 54,600 | | | |
| | 144,500 | 107,100 | | | |

[1] Of these totals secondary copper reported by smelters and refiners that treat mainly primary metal comprised 156,606 tons in 1937 and 92,542 tons in 1938.
[2] 611 pounds, gross weight.
[3] 190 pounds, gross weight.

The terms "new brass scrap" and "new copper scrap," as applied in the preceding table, refer to the scrap accumulated in fabricating products; "old scrap" is the metal that was made into products and after service has been discarded and returned to be remelted or refined for further use. Few junkmen, dealers, or smelters keep any statistics of "old scrap" and "new scrap." Most of the new scrap is clippings, grindings, and defective articles made in the ordinary operations in

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fabricating goods, some of which is reused at the plant and the remainder sold. All foundries and rolling mills (many of which purchase scrap metals) are advised in the Bureau of Mines questionnaire to exclude all scrap made and used in their own plants and to give data on purchased scrap alone. Those that purchase only "new scrap" of certain grades and assay can give correct data; the others usually can make some distinction between "new" and "old" scrap. Secondary smelters usually cannot give exact figures but occasionally can estimate the proportion of "new" scrap metal treated. The figures in the preceding table are the best obtainable.

Reports for 1938 show that railroads reused the following quantities of scrap metals at their shops and foundries: 6,730 tons of brass; 592 tons of copper; 9,071 tons of copper in alloys other than brass; 990 tons of tin in babbitt, solder, and bronze; and 4,400 tons of lead in various alloys.

*Secondary lead.*—The output of secondary lead in 1938 equaled 58.6 percent of the total production of refined primary lead from domestic and foreign sources in the United States compared with 59 percent in 1937. Much recovered lead is derived from discarded batteries, pipe, sheet, and lead-covered cable; other sources are type metal, solder, babbitt, and shot.

Secondary lead recovered by smelters whose product is mainly primary metal decreased 5,186 tons in 1938. The output of pig lead by secondary smelters decreased about 29,900 tons and that of lead in scrap alloys 10,879 tons.

Owing to the greatly decreased output of motor cars and the smaller number of scrapped cars in 1938 the quantity of old batteries smelted was much less than in 1937. Apparently urban dealers collected fewer batteries but did not hold them for higher prices. Some stocks of batteries are held in rural areas, but the total quantity is not large. Recovery of battery plates is expected to increase in 1939 because purchases of new motor cars are larger. A number of secondary smelters treating old batteries and other lead alloys now recover much of the lead as good-grade pig lead. The residues and drosses containing antimony are then used in making hard lead containing various percentages of antimony. Some of the problems in handling old batteries are stated in an article by Neuman.[6]

*Secondary lead recovered in the United States, 1937–38, in short tons*

| | 1937 | 1938 |
|---|---|---|
| Secondary lead recovered by smelters that treat mainly ore | 29,986 | 24,800 |
| Secondary lead recovered by smelters that treat only scrap and drosses | 124,514 | 94,600 |
| | 154,500 | 119,400 |
| Secondary lead recovered in remelted alloys: | | |
| Estimated secondary lead content of antimonial lead produced at regular lead smelters[1] | 15,391 | 11,170 |
| Lead content of drosses and scrap alloys treated at secondary smelters | 105,209 | 94,330 |
| | 120,600 | 105,500 |
| Total secondary lead recovered | 275,100 | 224,900 |

[1] Antimonial lead produced at primary smelters totaled 27,534 tons containing approximately 7,833 tons of primary domestic lead, 1,721 tons of primary foreign lead, 1,636 tons of primary domestic antimony, 90 tons of primary foreign antimony, 15,391 tons of secondary lead, and 853 tons of secondary antimony in 1937 compared with 24,123 tons containing approximately 6,759 tons of primary domestic lead, 3,385 tons of primary foreign lead, 2,080 tons of primary domestic and foreign antimony, and 11,170 tons of secondary lead, and 729 tons of secondary antimony in 1938.

[6] Neuman, E. A., Journey of Battery Plates from Dealer to Consumer: Waste Trade Jour., Mar. 27, 1937, pp. 89, 94.

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*Refined primary lead produced in the United States, 1937–38, in short tons*

| | 1937 | 1938 |
|---|---|---|
| From domestic ore | 443,142 | 331,964 |
| From foreign ore and base bullion | 24,175 | 51,705 |

The American Bureau of Metal Statistics estimates that each of the 14,500,000 automobile batteries made in 1938 contained an average of 21.6 pounds of lead and antimony, the same as in 1937. The average in each battery in 1936 was 23.7 pounds and in 1933, 25.1 pounds.

The sampling of battery plates is much more difficult than the assaying, owing to the moisture in the rubber and separators.

Numerous old batteries are smelted on toll by custom smelters. The smelters also purchase batteries at a price based on that of pig lead at St. Louis; the antimony content is, however, paid for at the price of lead, although the price of antimony in 1938 was about three times that of lead.

It is generally considered that too high prices have been and are being paid to holders of old batteries, that dealers pay too much for them, and in turn that the smelters' and refiners' profit is normally too small. Frequently the recovery of the antimony alone yields any profit. A humorously expressed argument for concerted action to remedy this condition was given in a paper [7] read at the meeting of the National Association of Waste Material Dealers on March 21–22, 1939. Old batteries are a problem to dealers and smelters as well as to the sellers of primary lead because they are scrapped and return to stocks in such a comparatively short time. Another article presented at the same meeting stated the factors other than the quoted prices of primary lead that determined the prices offered for battery lead.[8]

Admittedly there are many factors, which are stated, but the main one is that the selling price depends primarily on the price and activity of antimonial lead and not on the price of and demand for primary lead.

*Secondary zinc.*—Secondary zinc recovered as pig metal and in alloys (including brass) decreased 40,220 short tons. The zinc content of brass remelted was 13,200 tons less in 1938 than in 1937. The total recovery of secondary zinc (including that in brass) equaled 20 percent of the total output of primary slab zinc in the United States (446,341 tons) in 1938. In addition, large quantities of the zinc dust, zinc chloride, and other compounds were made from zinc drosses and residues.

[7] Friedman, Benjamin, Give Battery Lead a Break: Waste Trade Jour., Apr. 1, 1939, p. 63.
[8] Neuman, E. A., Some Misconceptions of Battery Lead Scrap Prices Paid by Smelters: Waste Trade Jour., Apr. 1, 1939, pp. 73–74.



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*Secondary zinc* [1] *recovered in the United States, 1937–38, and products made from zinc dross, skimmings, and ashes, in short tons*

| | 1937 | 1938 |
|---|---|---|
| Secondary zinc recovered by redistillation | 51,554 | 31,613 |
| Secondary zinc recovered by sweating, remelting, etc. | [2] 12,986 | 10,657 |
| Total zinc recovered unalloyed | [2] 64,540 | 42,270 |
| Zinc recovered in alloys other than brass | 11,150 | 6,400 |
| Zinc recovered in brass (estimated) | 51,600 | 38,400 |
| Zinc dust made from zinc dross | 15,242 | 11,609 |
| Zinc concentrates and ore exported | 314 | 135 |
| Zinc dross exported | | |
| Lithopone made from zinc skimmings and ashes | 66,064 | 58,563 |
| Secondary zinc content of lithopone | 13,040 | 11,262 |
| Zinc chloride made from zinc skimmings, ashes, etc. | [3] | [3] |
| Zinc content of zinc chloride made from zinc skimmings, etc. | [3] | [3] |
| Zinc content of zinc sulphate made from zinc skimmings, ashes, etc. | 1,735 | 1,395 |
| Zinc oxide produced from zinc scrap and drosses | 10,349 | 9,357 |

[1] Figures do not include scrap and dross used for lithopone or chloride. The use for zinc chloride, especially, is large.
[2] Revised figures.
[3] Data not available.

Zinc recovered by redistillation decreased from 51,554 tons in 1937 to 31,613 in 1938. Of the 1938 total, 14,003 tons (a decrease of 10,128 tons) were recovered at primary smelters from zinc drosses and 17,610 (a decrease of 9,813 tons) at six secondary plants that used large graphite retorts, two plants that used clay retorts, and one that used both, which treated only drosses and residues in 1938. The large decrease in the recoveries of redistilled zinc was the normal result of the greatly reduced quantity of zinc used in zincking and in die casting. It is estimated that 40 to 45 percent less zinc was used in die casting in 1938 than in 1937. Much of the decrease was due to the sharp decline in the number of motorcars made in 1938. The seven active smelters using large graphite retorts in 1938 were:

W. J. Bullock, Fairfield, Ala.
Federated Metals Corporation, Trenton, N. J.
General Smelting Co., Philadelphia, Pa.
Nassau Smelting & Refining Co., Tottenville, N. Y.
Pacific Smelting Inc., Ltd., Torrance, Calif.
Superior Zinc Corporation, Bristol, Pa.
Wheeling Steel Corporation, Wheeling, W. Va.

Of the total output of 122,297 tons of lithopone in 1938, 58,563 tons containing 11,262 tons of zinc were made from zinc skimmings and ashes.

The American Bureau of Metal Statistics estimates that 198,000 tons of zinc (54,000 tons less than in 1937) were used in 1938 in zincking (galvanizing) sheets, forms, tubes, wire, and other products.

*Secondary tin.*—Secondary tin recovered amounted to 23,610 tons valued at $19,284,648 in 1938 compared with 30,300 tons valued at $32,124,100 in 1937. The total value assigned is based on the yearly average price (40.84 cents in 1938 and 53.01 in 1937) given by the American Metal Market for 99-percent metal, prompt delivery at New York.

Figures for recovery of pig tin for earlier years are not comparable with 1936, 1937, and 1938, as all tin recovered at tin-plate plants by

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operators by treating tin scruff was eliminated beginning in 1936. This tin is recovered in the ordinary course of operations at nearly all plants, and its elimination decreased 1936, 1937, and 1938 totals about 2,000 tons. The tin recovered in alloys and chemical compounds decreased 3,320 short tons in 1938. Secondary tin recovered in 1938 was equivalent to about 42.4 percent of the tin imported into the United States as pig metal in 1938.

According to reports to the Bureau of Mines, 1,510,502 long tons of tin plate and terneplate were made in 1938. It is estimated that about 25,567 long tons of tin were used in these products and that 3,921 short (3,502 long) tons of tin were recovered from tin-plate clippings and old coated containers.

Owing to the relatively high value of tin, it is important that the degree of accuracy be high in obtaining representative samples of shipments of tin dross and in analyzing them later.[9]

Many earlier chapters of this series contain data on plants and processes followed, and a complete history of the different methods of detinning has been published by Mantell.[10]

The rules of procedure governing issuance of licenses for exportation of tin-plate scrap during 1939 were released by the Department of State on December 16, 1938. Allotments will be based on each individual producer's request therefor, with the provision that no allotment of more than 25 long tons shall exceed 20 percent of the tin-plate scrap produced by him during the calendar year 1937. No allotment to any producer shall exceed 2,000 tons. Export quotas for 1938 were based on 25 percent of 1937 production, and a total of 15,000 tons was assigned. In all, 187 licenses actually were issued authorizing the exportation of 13,237 tons of tin-plate scrap valued at $226,728.47. All licenses issued during 1938 named Japan as the country of destination.

H. R. 5840 (76th Congress) proposes to extend the licensing feature of the Faddis-Barbour Law to "other scrap, drosses, or residues, the tin content of which is in excess of 10 per centum in which the copper content does not exceed the tin content." This bill passed the House of Representatives on May 1, 1939. Details of other Government action affecting tin and a discussion of the national defense aspects of tin are given in the Tin chapter of this volume.

Notwithstanding the fact that the price of tin decreased about 12 cents a pound in 1938 some old tin-coated containers were treated at detinning plants, although the quantity decreased about 1,800 long tons. Many more old cans could be treated at existing plants, but collections are restricted to areas adjacent to the plants because of the cost of collecting, shipping, and cleaning such bulky material. A large quantity of old cans is disintegrated at Los Angeles and used at copper mines in Utah and other States, but no attempt is made to recover the tin coating.

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[9] Kasey, J. B., A Suggested Method for Preparing Deliquescent Tin Dross Samples: Metal Ind., September 1936, p. 338.

[10] Mantell, C. L., Scrap Detinning Affords Big Outlet for Chlorine: Chem. and Met. Eng., 1926, pp. 477–479.

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*Secondary tin recovered in the United States, 1937–38*

| | 1937 | 1938 |
|---|---|---|
| Tin recovered as pig tin.....short tons.. | 8,270 | 4,900 |
| Tin recovered in alloys and chemical compounds.....do.... | 22,030 | 18,710 |
| | 30,300 | 23,610 |
| Clean tin-plate scrap treated at detinning plants.....long tons.. | 247,723 | 209,474 |
| Metallic tin recovered at detinning plants.....pounds.. | 5,700,942 | 4,982,836 |
| Tin content of tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants.....pounds.. | 3,378,760 | 2,778,370 |
| Total tin recovered at detinning plants.....do.... | 9,079,702 | 7,761,206 |
| Tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants.....pounds.. | 6,956,685 | 5,514,072 |
| Average quantity of tin recovered per long ton of clean tin-plate scrap.....do.... | 36.7 | 37.05 |

*Tin (metal) and tin concentrates (tin content) imported into the United States, 1936–38, in short tons*

| | 1936 | 1937 | 1938 |
|---|---|---|---|
| Tin imported as metal | 85,152 | 98,689 | 55,663 |
| Tin concentrates (tin content) imported | 200 | 169 | (1) |

[1] Less than 1 ton.

The quantity of tin-plate clippings treated at detinning plants decreased about 28,250 long tons in 1938, and the average cost of such clippings delivered at plants decreased from $19.38 a long ton in 1937 to $11.42 in 1938. These clippings were treated at plants of the Vulcan Detinning Co. at Sewaren, N. J., Neville Island, Pa., and Streator, Ill.; of the Johnston & Jennings Co. at Cleveland, Ohio; and of the Metal & Thermit Co., at South San Francisco, Calif., East Chicago, Ind., and Chrome, N. J.

Imports of tin-plate scrap in 1938 totaled 10,444 long tons valued at $81,685 compared with 12,916 tons valued at $179,459 in 1937. Of these amounts, Canada supplied 11,881 tons valued at $170,925 in 1937 and 10,682 tons valued at $74,658 in 1938.

Exports of tin-plate scrap decreased from 14,126 long tons valued at $246,770 in 1937 to 12,495 tons valued at $227,874 in 1938. Japan took all the exports in 1937 and 1938. This material would yield Japanese detinners about 35 pounds of tin per long ton.

Exports of waste tin plate decreased from 26,259 long tons valued at $2,022,955 in 1937 to 7,255 tons valued at $474,689 in 1938, of which Japan took about 71 percent in 1937 and about 16 percent in 1938.

The tin reported recovered in alloys and compounds in 1938 included the tin content of products made from clean tin-plate scrap. Most of the tin recovered at the plants listed was in sodium stannate, tin crystals, tin tetrachloride, and tin oxide.

The total recovery of tin as metal or in compounds from clean tin-plate scrap in 1938 was 3,881 short tons, whereas it is estimated that makers of tin plate and terneplate consumed nearly 24,552 long tons of tin. Some old tin-coated containers treated at Chrome, N. J., yielded 27.3 pounds of tin per long ton.

*Secondary aluminum.*—The recovery of secondary aluminum, including that in alloys, totaled 38,800 short tons valued at $15,326,000

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compared with 62,560 tons valued at $23,773,000 in 1937. The value in 1937 was computed at 19 cents a pound and in 1938 at 19.75 cents a pound.

The value of primary aluminum produced in the United States increased from $55,609,000 in 1937 to $56,659,000 in 1938.

*Secondary aluminum recovered in the United States, 1937–38, in short tons*

| | 1937 | 1938 |
|---|---|---|
| Secondary aluminum recovered unalloyed | 29,360 | 16,700 |
| Aluminum recovered in alloys (mainly No. 12) | 33,200 | 22,100 |
| | 62,560 | 38,800 |

*Primary aluminum produced in the United States and imported and exported, 1937–38, in pounds*

| | 1937 | 1938 |
|---|---|---|
| Primary aluminum produced in the United States | 292,681,000 | 286,882,000 |
| Aluminum (crude and semicrude) imported for consumption | 45,178,069 | 17,740,281 |
| Aluminum (crude and semicrude) exported | 5,383,516 | 12,618,078 |

Prices for scrap cast aluminum ranged from 9.37 cents a pound in January to as low as 4.62 cents in June. New aluminum clippings had a spread of 2.5 cents a pound in 1938, ranging from 14 cents in January to a low of 11.5 cents in June. Demand was sagging and prices were low from April to August. Scrap-aluminum clippings remelted in the ordinary course of shop practice were excluded from 1938 recoveries wherever possible. About 400 tons of aluminum clippings were purchased by makers of metallic powders in 1938. These pure clippings are the most suitable material for this purpose, but frequently it is difficult to purchase them, for a large quantity is remelted and rolled into sheet aluminum.

A progress report of the Aluminum Research Institute by its secretary, R. D. T. Hollowell,[11] gives the following interesting information, which is abstracted from that report:

Just as long as satisfactory secondary aluminum is produced at prices that compare favorably with those paid for primary metal it is unprofitable for foundrymen to use virgin metal if secondary metal will produce equally good results.

Prior to about 1916 the chemical composition of secondary aluminum ingot was governed almost entirely by the chemical composition of the scrap from which it was made. Pure clippings and sheet scrap (which in those days was pure) were commonly added to reduce the percentage of impurities but the impurities were not eliminated. Fluxing was practiced in the heating of the dross so that it could be more easily separated from the bath of molten metal. Prior to 1924 the scrap aluminum that came on the market was chiefly No. 12 casting alloy, which contained 92 percent aluminum and 8 percent copper. Aluminum sheet in those days was about 99 percent pure.

New aluminum alloys were soon developed. Manganese was one of the early elements to be added to aluminum. Then came silicon and more complex alloys with magnesium. Today, we find aluminum alloys containing one or more of the following alloying elements: Nickel, manganese, silicon, lead, tin, titanium, chromium, and magnesium. Beryllium, calcium, lithium, and sodium were also introduced into aluminum alloys. Of late, the increased use of magnesium castings has further complicated the problem due to the fact that it is difficult to distinguish magnesium from aluminum castings by appearance only. Today, certain

[11] Hollowell, R. D. T., Secondary Aluminum and Its Alloys: Nat. Waste Rev., April 1939, pp. 15–17.

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grades of nonmagnetic stainless steels stray into the aluminum scrap and make sorting still more difficult.

In order to keep pace with the introduction of all these different alloys, the successful "remelter" was forced to develop into a refiner. In order to produce secondary metal with known properties and definite analysis, he found it necessary to operate chemical and metallurgical laboratories.

Not only does the laboratory of an up-to-date aluminum refiner obtain exact chemical analysis of the scrap and finished ingot, but it also checks the finished metal for tensile strength, elongation, hardness, impact resistance, and other physical properties.

The modern smelter maintains an experimental foundry in which the fluidity and shrinkage of the ingot are determined before shipping to a customer. Intricate designs are poured to check foundry quality. Castings are poured at high temperatures to determine freedom from stain or discoloration.

The results obtained from these more or less routine tests taught the modern smelter that, in order to obtain uniformity, he must of necessity remove some of the harmful impurities—in other words, he must truly refine the metal. It is with a great deal of pride that the Aluminum Research Institute now reports that its members remove not only oxides, nonmetallic inclusions, and gases, but also free the aluminum from certain alloying elements which interfere with foundry properties and which mar the appearance of the finished castings.

This progress in refining practice is due in no small measure to the maintenance by the leading refiners of true research laboratories—laboratories quite divorced from routine analysis and plant control. The equipment in some of these laboratories compares favorably with the metallurgical equipment maintained by manufacturers in other important fields.

There was a time when consumers thought that secondary aluminum was distinctly inferior to virgin metal, and that, consequently, it could not be used for their more exact requirements. Today, secondary aluminum manufactured by a responsible smelter who maintains complete laboratory service, can be satisfactorily used for almost any purpose where primary metal is regularly employed. This does not mean that secondary metal, irrespective of composition and quality, can be substituted for good grades of primary metal. It does mean that secondary metal of the required composition, properly made and refined, is metallurgically equivalent to primary aluminum in every respect.

The complexity of the aluminum scrap that is coming on the market today is the reason why most up-to-date foundries have either discontinued entirely, or soon will be confronted with the necessity of discontinuing, the use of scrap aluminum. For the last year or two, it has been almost impossible for the foundryman to buy pure aluminum in the form of clippings. Practically all clippings are comingled with alloy clippings, such as duraluminum and others. Cast aluminum is still being purchased and used as scrap by some of the smaller foundries. The increased number of casting alloys now used makes it more and more difficult for the average foundry to duplicate the refining process followed by the modern secondary aluminum manufacturer, unless the foundry is able to buy in tremendous quantities and put in its own control laboratories for checking raw materials and finished products.

Ever since its organization, the Aluminum Research Institute has endeavored to standardize the alloys most commonly used by aluminum foundries. In cooperation with the National Association of Waste Material Dealers, the Institute published standard purchase specifications for all grades of aluminum scrap. These have been accepted as standard by the entire aluminum industry.

One of the greatest services the Institute has rendered to the industry lies in the field of chemical analysis. When the industry was in the purely "remelt" stage, little attention was paid to chemical analysis. Later, however, the necessity for laboratory control led to the discovery that the analysis of the same alloy made by different laboratories did not check. When, in the case of a dispute, an outside chemist was called in, his analysis was often quite different from all the others. The result was frequent disputes, losses through rejections of material, and unsatisfactory dealings between the smelter and his customers.

At one of the early meetings of the Institute, it was decided to prepare a standard check sample to see how our own laboratories checked with each other. When member laboratories reported widely varying results, something had to be done. The Aluminum Company of America had previously prepared standard methods of analysis, but these methods, while well fitted to alloys made of new metals of high purity, were not always satisfactory for analyzing the more complex and comingled secondary alloys.

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The Institute, after several years of painstaking work, prepared standard methods of analysis for secondary aluminum. In 1932 these methods were published and widely distributed. By their use, check results were obtained. The chemists committee of the Institute, responsible for these methods, has continued its work. Many carefully prepared samples have been distributed for check and standardization purposes. Many new methods have been tried out. Many important changes have been made in the original analytical methods. New improved methods are now being prepared for publication and will soon be ready for distribution to those interested.

The Aluminum Research Institute is preparing and plans to have available about July 1 standard samples of secondary aluminum of known chemical analysis. These samples will be sold at cost to any laboratory interested in aluminum and may be used for check purposes.

The Aluminum Research Institute has taken the lead in the last few years in developing specifications for certain grades of secondary aluminum alloys. These specifications are rigidly adhered to by members of the Aluminum Research Institute, and they are in a position to furnish alloys to these specifications which will, when properly cast, show the physical properties indicated.

We wish to express our appreciation of the time you have so courteously extended to us. We pledge to you in the name of our Association members our unceasing efforts to continue to improve our product and to cooperate with you in the solution of your problems.

*Secondary antimony.*—The principal materials refined or remelted that contained antimony as an alloy were hard-lead drosses, babbitt, bearing metal, battery plates, pewter, and type metal. The antimony used in the pigment, paint, and ceramic industries is so dissipated that no secondary recoveries can be made, but a large proportion of the production of metal containing antimony returns in a few months or years for refining and reuse. Antimony in type metal and in bearings returns very rapidly for refining. This large return of scrap in type and bearing metals normally goes to the makers of type and bearing alloys, which restricts the market for antimonial lead. It may take several years for antimony in battery plates to return as scrap, but probably 80 to 85 percent is certain to come back for reuse in less than 3 years.

The production of secondary antimony in the United States, most of which was recovered in alloys, decreased in 1938. The average price for ordinary brands (Chinese grade) of antimony, as stated by the American Metal Market, was 12.35 cents a pound in 1938 compared with 15.35 cents in 1937. Smelters that ordinarily use primary ores, concentrates, or metal reported 2,080 tons of primary antimony and 729 tons of secondary antimony as contained in 24,123 tons of antimonial lead. The recovery of secondary antimony by secondary smelters decreased 3,716 tons.

Imports of antimony in ore, as metal, or in oxide were 7,116 tons less than in 1937.

*Secondary antimony recovered in and antimony imported into and exported from the United States, 1937–38, in short tons*

| | 1937 | 1938 |
|---|---|---|
| Secondary antimony in antimonial lead scrap smelted at regular smelters | 853 | 729 |
| Secondary antimony recovered at secondary smelters | 11,487 | 7,771 |
| | 12,340 | 8,500 |
| Antimony imported in ore, as metal, or as oxide or salts | 16,769 | 9,653 |
| Foreign antimony exported | 437 | 711 |

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*Secondary nickel.*—The nickel reported as recovered from secondary sources includes nickel in Monel metal (the natural alloy) but not that in ferrous alloys. The practice of using small quantities of nickel in iron and steel as well as in brasses and bronzes expanded greatly in both 1937 and 1938. Activity was much less at foundries in 1938. A large part of their products contained some nickel.[12]

Nickel often was substituted for tin to reduce costs in certain alloys requiring tensile strength and ductility.

Most of the secondary nickel recovered in 1938 came from scrap—nickel anodes, nickel-silver, copper-nickel alloys, and Monel metal. Exports of nickel scrap and scrap alloys containing nickel decreased. It is impossible to give the nickel content of all the exports of such nickel-bearing scrap, but the total nickel content reported by exporters who submitted data to the Bureau of Mines was 991 tons in 1937 and 870 in 1938.

Although the trend toward the use of nickel in iron and steel alloys increased in 1938, the secondary nickel recovered in ferrous alloys was undoubtedly less in 1938 than in 1937. Robert C. Stanley, president of the International Nickel Co., Ltd., estimates that about 42 percent of all nickel consumed in the United States is used in nickel iron and steel, mainly in motor cars, railway equipment, heat-resistant alloys, and machinery. Few of these industries expanded in 1938.

Probably more secondary nickel is recovered from ferrous than from nonferrous alloys, but no figures are available. Certain alloys give uninformed dealers trouble.[13]

Scrap iron and steel dealers frequently are careless in handling alloy ferrous scrap, and certain discarded equipment and automobile scrap that contain nickel are thrown in with the regular steel scrap instead of being kept separate and advantage taken of their greater value.[14]

*Secondary nickel recovered in the United States, 1937–38, in short tons*

| | 1937 | 1938 |
|---|---|---|
| Nickel recovered as metal | 917 | 850 |
| Nickel recovered in nonferrous alloys and salts | 1,483 | 1,450 |
| | 2,400 | 2,300 |

*Primary nickel produced in the United States and imported and exported, 1937–38 in short tons*

| | 1937 | 1938 |
|---|---|---|
| Nickel produced as a byproduct from the electrolytic refining of copper at domestic refineries | 219 | 416 |
| Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys | 54,438 | 29,545 |
| Nickel, Monel metal, and other alloys exported | 3,817 | 5,921 |

[12] Curry, D. M. (International Nickel Co.), Nickel in Brass-Foundry Practice: Metal Ind., New York, 1936, pp. 330, 332.

[13] Edelstein, Joel, Nickel Alloys in Scrap Metals: Waste Trade Jour., March 28, 1936, pp. 83, 87; Trials of a Nickel Specialist: Waste Trade Jour., March 26, 1938, p. 139.

[14] Wilenchik, I. W., Profits in Nickel Alloys: Waste Trade Jour., Mar. 27, 1937, p. 147.

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## CLASSIFICATION OF OLD METALS

The classification of old metals drawn up by the Metals Division of the National Association of Waste Material Dealers, Inc., Times Building, New York, N. Y., and changed from time to time as desirable, is the standard of both dealers and manufacturers in the United States. The latest classification (Circ. M), effective March 16, 1932, was given in the Secondary Metals chapter, Minerals Yearbook, 1936. No immediate changes in this classification are contemplated.

There is a growing demand for scrap-metal specialties (not specifically covered by the classification), such as nickel alloys, German silver, Monel metal, cadmium, and molybdenum. Difficulties have arisen in making shipments to buyers' specifications, and with the object of eliminating some of the trouble the Waste Trade Journal published classifications used by one of its advertisers. A list of these was given on pages 338 and 339 of the Secondary Metals chapter in Mineral Resources of the United States, 1930, part I.

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# SCRAP IRON AND STEEL

By JAMES S. EARLE

## SUMMARY OUTLINE


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In presenting this new chapter of Minerals Yearbook attention is directed to the annual surveys on the consumption of ferrous scrap and pig iron in the United States beginning with 1935. The results of the 1935, 1936, and 1937 surveys have been published as separate reports.[1] In the canvass of consumers of ferrous scrap and pig iron, data are obtained only on scrap used in remelting processes. Material salvaged and reused in its original condition, or reshaped, is thus omitted from the survey.

Scrap has been divided into materials described as "home" and "purchased." The former includes scrap resulting from manufacturing processes, as well as old material produced at the plant reporting. As the name implies, the latter consists not only of scrap purchased from outside sources but also of scrap transferred from other plants under the same control and scrap received under exchange contracts or conversion agreements. No attempt has been made to differentiate between "old" and "new" scrap because ferrous-scrap accumulations contain both old and new material which is difficult to segregate statistically.

Although some concerns may utilize high proportions of old plant scrap for a limited period, in general the material included under the heading of home scrap largely represents recycled or run-around scrap and may be considered by many as merely rotating working stock rather than as actual consumption. However, this scrap constitutes a definite part of the furnace charges and must be included to obtain a complete picture of raw-material consumption in steel manufacture.

[1] Lund, R. J., and Davis, H. W., Consumption of Ferrous Scrap and Pig Iron in the United States in 1935: Bureau of Mines Rept. of Investigations 3329, 1936, 16 pp.
Ridgway, R. H., Davis, H. W., and Trought, M. E., Consumption of Ferrous Scrap and Pig Iron in the United States in 1936: Bureau of Mines Rept. of Investigations 3366, 1937, 21 pp.; Consumption of Ferrous Scrap and Pig Iron in the United States in 1937: Bureau of Mines Rept. of Investigations 3420, 1938, 22 pp.



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This is particularly applicable as long as ingot production (which includes a large part of this recycled scrap) remains the yardstick for measuring activity in the steel industry.

## GENERAL SUMMARY

Consumption of scrap iron and scrap steel in the United States decreased sharply in 1938 from that in 1937 owing to the low rate of industrial production. Prices received little support from the domestic market during the first part of 1938 and, as foreign demand weakened, reached the low point of the year in June. At that time foreign purchasers again entered the market, but prices did not react sharply until the latter part of July following improvements in the domestic market occasioned by the increasing rate of industrial production which began early in that month. The higher price levels reached early in the last quarter were maintained until the close of the year.

Exports of ferrous scrap from the United States dropped 27 percent in 1938 compared with 1937. However, the tonnage and value of the exports in 1938 were second only to those in 1937, when record shipments were made. Consignments of scrap from the United States to Japan, the United Kingdom, Poland, and Canada were curtailed sharply in 1938, but those to Italy, Germany, and the Netherlands showed a marked gain.

The question of the embargo on exports of scrap iron and scrap steel (S. 2025, 75th Cong.), which was raised in 1937 when prices and world production of steel were skyrocketing, received little support in 1938, with the result that the bill was allowed to die in committee. However, similar bills were introduced in the Seventy-sixth Congress early in 1939.

The importance of scrap from the standpoint of conservation is illustrated by the relative quantities of scrap and ore used in the domestic iron and steel industry. The total scrap consumed in 1938 was equivalent to 132 percent of the iron content of all domestic and foreign iron and manganiferous iron ores used in blast furnaces, and purchased scrap alone equaled 62 percent of the iron content of the ores; in 1937 the comparable percentages were 119 and 57.

The total consumption of ferrous scrap and pig iron in 1938 decreased 45 percent from 1937, as shown in the following table. Of the 39,849,283 gross tons used, 31,350,025 tons were charged to steelmaking furnaces and 8,499,258 tons to iron furnaces. In making the average ton of steel in 1938 more scrap and less pig iron were used than in 1937; a decline in the relative use of purchased scrap was more than offset by an increase in the relative use of home scrap. In iron furnaces the relative use of purchased scrap increased, that of home scrap changed little, and that of pig iron decreased.

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*Summary statistics of ferrous scrap and pig iron in the United States, 1937–38*

| | 1937 | 1938 | Decrease in 1938 |
|---|---|---|---|
| Ferrous scrap and pig iron charged to— | *Gross tons* | *Gross tons* | *Percent* |
| Steel furnaces: [1] | | | |
| Home scrap | 15,006,136 | 8,521,258 | 43 |
| Purchased scrap | 13,364,226 | 7,137,455 | 47 |
| Pig iron | 28,851,266 | 15,691,312 | 46 |
| | 57,221,628 | 31,350,025 | 45 |
| Iron furnaces: [2] | | | |
| Home scrap | 4,864,897 | 2,800,083 | 42 |
| Purchased scrap | 4,771,013 | 2,886,138 | 40 |
| Pig iron | 5,205,261 | 2,813,037 | 46 |
| | 14,841,171 | 8,499,258 | 43 |
| All furnaces: | | | |
| Home scrap | 19,871,033 | 11,321,341 | 43 |
| Purchased scrap | 18,135,239 | 10,023,593 | 45 |
| Pig iron | 34,056,527 | 18,504,349 | 46 |
| | 72,062,799 | 39,849,283 | 45 |
| Ferrous scrap: | | | |
| Consumption | 38,006,272 | 21,344,934 | 44 |
| Exports: | | | |
| Iron and steel | 4,048,102 | 2,974,391 | 27 |
| Tin plate, waste-waste, circles, strips, cobbles, etc | 53,447 | 24,216 | 55 |
| Average prices per gross ton: | | | |
| Scrap: | | | |
| No. 1 heavy melting, Pittsburgh | $18.86 | $14.02 | 26 |
| No. 1 cast cupola | 18.50 | 15.13 | 18 |
| For export | 18.91 | 15.11 | 20 |
| Pig iron, f. o. b. Valley furnaces: | | | |
| Basic | 22.99 | 21.70 | 6 |
| No. 2 foundry | 23.49 | 22.20 | 5 |

[1] Includes open-hearth, bessemer, and electric furnaces.
[2] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.

The following table shows that scrap constitutes by far the greater part of the raw materials used in the Southwestern, Pacific Coast, and New England districts. These regions, however, used less than 6 percent of the total scrap consumed in 1938. Except for the Southeastern district, proportionately more scrap was used in all areas in 1938 than in 1937, although most of the increases were relatively small. Apparently, lower prices for scrap explained much of the increase in 1938, especially in outlying areas.

*Total ferrous scrap and pig iron consumed in the United States and percentage of total derived from home scrap, purchased scrap, and pig iron, 1937–38, by districts*

| District | 1937 | | | | | 1938 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total used (gross tons) | Percent of total used | | | | Total used (gross tons) | Percent of total used | | | |
| | | Scrap | | | Pig iron | | Scrap | | | Pig iron |
| | | Home | Purchased | Total | | | Home | Purchased | Total | |
| New England | 875,185 | 26.7 | 45.9 | 72.6 | 27.4 | 479,464 | 26.1 | 46.7 | 72.8 | 27.2 |
| Middle Atlantic | 24,684,871 | 26.4 | 22.2 | 48.6 | 51.4 | 12,025,365 | 28.8 | 22.1 | 50.9 | 49.1 |
| Southeastern | 8,600,595 | 25.1 | 22.6 | 47.7 | 52.3 | 6,238,315 | 25.3 | 19.9 | 45.2 | 54.8 |
| Southwestern | 223,468 | 23.2 | 66.1 | 89.3 | 10.7 | 138,187 | 25.5 | 71.3 | 96.8 | 3.2 |
| North Central | 35,733,265 | 29.3 | 25.7 | 55.0 | 45.0 | 19,783,190 | 29.4 | 26.0 | 55.4 | 44.6 |
| Rocky Mountain | 856,094 | 23.3 | 33.2 | 56.5 | 43.5 | 372,256 | 24.4 | 38.9 | 63.3 | 36.7 |
| Pacific Coast | 1,089,321 | 23.1 | 62.3 | 85.4 | 14.6 | 812,506 | 24.5 | 64.0 | 88.5 | 11.5 |
| | 72,062,799 | 27.6 | 25.1 | 52.7 | 47.3 | 39,849,283 | 28.4 | 25.2 | 53.6 | 46.4 |

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Figure 1 shows consumption of purchased scrap and output of pig iron and steel ingots and castings from 1905 to 1938, inclusive.

Open-hearth steel furnaces use by far the largest quantities of ferrous scrap and pig iron. They consumed 68 percent of the total scrap in 1938 (69 percent in 1937), 70 percent of the home scrap (70 percent in 1937), 66 percent of the purchased scrap (69 percent in 1937), and 74 percent of the pig iron (74 percent in 1937).

Cupolas, the second largest consumers of scrap, took 24 percent of the purchased scrap in 1938 compared with 20 percent in 1937. They increased slightly their relative consumption of home scrap (15 percent) and pig iron (13 percent).

Open-hearth and cupola furnaces together consumed 85 percent of the home scrap, 90 percent of the purchased scrap, and 87 percent of the pig iron in 1938. Bessemer converters used 11 percent of the pig iron consumed in 1938 but only relatively small quantities of scrap (0.54 percent of the total). Although electric furnaces consumed only 4 percent of the scrap in 1938, 98 percent of the total charge to this type of equipment was home and purchased scrap.

*Consumption of ferrous scrap and pig iron in the United States, 1937–38, by type of furnace, in gross tons*

| Type of furnace or equipment | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| **1937** | | | | | |
| Open-hearth | 142 | 13,957,619 | 12,456,418 | 26,414,037 | 25,118,216 |
| Bessemer | [1] 30 | 221,460 | 9,043 | 230,503 | 3,688,335 |
| Electric | [1] 268 | [2] 827,057 | [2] 898,765 | [2] 1,725,822 | [2] 44,715 |
| Cupola | [1] 2,611 | [3] 2,878,395 | [3] 3,629,078 | [3] 6,507,473 | [3 4] 4,195,234 |
| Air | [1] 121 | [5] 513,075 | [5] 231,221 | [5] 744,296 | [5] 444,988 |
| Brackelsberg | 2 | | | | |
| Crucible | 13 | 815 | 551 | 1,366 | 43 |
| Puddling | 7 | 4,551 | 6,649 | 11,200 | 31,489 |
| Blast | 81 | 1,468,061 | 903,514 | 2,371,575 | |
| Direct castings | 13 | | | | [4] 533,507 |
| | [1 6] 3,288 | 19,871,033 | 18,135,239 | 38,006,272 | 34,056,527 |
| **1938** | | | | | |
| Open-hearth | 135 | 7,956,151 | 6,651,479 | 14,607,630 | 13,729,371 |
| Bessemer | 26 | 111,751 | 3,695 | 115,446 | 1,946,048 |
| Electric | 257 | 453,356 | 482,281 | 935,637 | 15,893 |
| Cupola | 2,611 | 1,740,688 | 2,451,214 | 4,191,902 | [4] 2,404,637 |
| Air | 120 | 294,414 | 130,798 | 425,212 | 185,514 |
| Brackelsberg | 2 | | | | |
| Crucible | 22 | 592 | 622 | 1,214 | 218 |
| Puddling | 7 | 557 | 2,926 | 3,483 | 5,343 |
| Blast | 71 | 763,832 | 300,578 | 1,064,410 | |
| Direct castings | 15 | | | | [4] 217,325 |
| | [6] 3,266 | 11,321,341 | 10,023,593 | 21,344,934 | 18,504,349 |

[1] Revised figures.
[2] Revised to include 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron.
[3] Revised to include 12,814 tons of home scrap, 2,387 tons of purchased scrap, and 58,969 tons of pig iron; and to exclude 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron.
[4] Includes some pig iron used in making direct castings.
[5] Revised to exclude 12,814 tons of home scrap, 2,387 tons of purchased scrap, and 58,969 tons of pig iron.
[6] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

The percentage composition of charges to various types of furnaces, in terms of scrap and pig iron, are shown in the following table. The proportions of scrap and pig iron used in steel furnaces changed

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only slightly in 1938 compared with 1937. However, the proportion of total scrap used in iron furnaces (cupola and air) increased, whereas that of pig iron decreased.

*Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1937–38, in percent*

| Type of furnace | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Scrap | | | Pig iron | Scrap | | | Pig iron |
| | Home | Purchased | Total | | Home | Purchased | Total | |
| Open-hearth | 27.1 | 24.2 | 51.3 | 48.7 | 28.1 | 23.4 | 51.5 | 48.5 |
| Bessemer | 5.7 | .2 | 5.9 | 94.1 | 5.4 | .2 | 5.6 | 94.4 |
| Electric | 46.7 | 50.8 | 97.5 | 2.5 | 47.6 | 50.7 | 98.3 | 1.7 |
| Cupola | [1] 26.9 | [1] 33.9 | [1] 60.8 | [1] 39.2 | 26.4 | 37.1 | 63.5 | 36.5 |
| Air [2] | [1] 43.1 | [1] 19.5 | [1] 62.6 | [1] 37.4 | 48.2 | 21.4 | 69.6 | 30.4 |
| Crucible | 57.8 | 39.1 | 96.9 | 3.1 | 41.4 | 43.4 | 84.8 | 15.2 |
| Puddling | 10.6 | 15.6 | 26.2 | 73.8 | 6.3 | 33.2 | 39.5 | 60.5 |
| Blast | 61.9 | 38.1 | 100.0 | ..... | 71.8 | 28.2 | 100.0 | ..... |

[1] Revised figures.
[2] Includes data for 2 Brackelsberg furnaces.

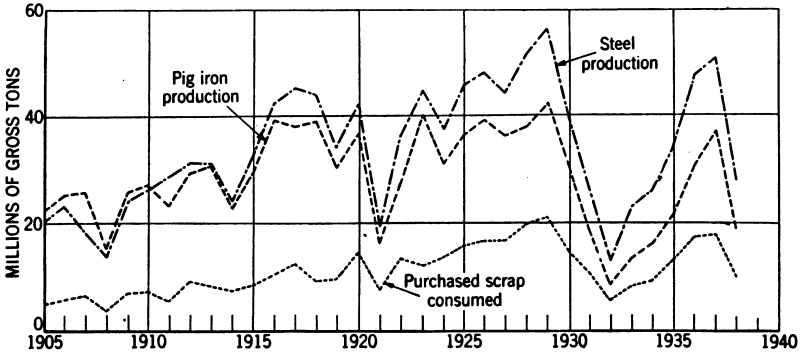


FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–38. Figures on consumption of purchased scrap for 1905–32 are from *State of Minnesota* vs. *Oliver Iron Mining Co. et al.*, Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimates by author; and those for 1935–38 are based on Bureau of Mines reports. Figures on output of pig iron and steel are as given by the American Iron and Steel Institute.

## PRICES [2]

Average prices of scrap iron and scrap steel in 1937 reached the highest levels since 1923 but had fallen off approximately 37 percent by the close of the year and fell still lower in 1938. The average price of No. 1 heavy-melting steel at Pittsburgh declined from $14.25 per gross ton at the beginning of 1938 to $11.30 the middle of June, then rose to $15.75 at the close of the year. No. 1 cast cupola scrap declined from an average of $16.25 at the beginning of 1938 to $13.45 in June, then rose to $15.50 by October where it remained to the end of the year. The price of basic pig iron, established at $23.50 per gross ton at Valley furnaces in April 1937, prevailed until late in June 1938, at which time it dropped to $19.50; in late September the price rose to $20.50 where it stood throughout the last quarter of the year.

[2] Price quotations from The Iron Age.

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## LEGISLATION

During the first half of 1938, when the trends of industrial activity and demand for scrap were downward, interest in scrap iron and scrap steel centered largely in the proposed embargo on exports. Senator Schwellenbach's bill (S. 2025, 75th Cong.) to restrict foreign shipments of ferrous scrap was patterned after the Faddis-Barbour bill (Public Law, 448, 74th Cong.), which prohibits exports of tinplate scrap, waste-waste, strips, cobbles, etc., except under license issued by the President. Final hearings on S. 2025 were held in April 1938 before a subcommittee of the Committee on Military Affairs of the United States Senate. Extensive testimony was presented on both sides.[3] Pressure for the passage of the bill moderated after the slump in steel production and scrap prices which took place late in 1937 and early in 1938, and the bill died in committee. Further consideration of the proposal, however, is assured.

## CONSUMPTION BY DISTRICTS AND STATES

All 48 States, the District of Columbia, and Alaska contain plants consuming ferrous scrap or pig iron. The greatest consumption, however, is concentrated in the steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas include the eight largest consuming States, which used 81 percent of the total scrap, 91 percent of the pig iron, and 85 percent of the total scrap and pig iron charged into furnaces in 1938. These States and the percentage of the total ferrous scrap and pig iron each consumed in 1938 were as follows: Pennsylvania 24, Ohio 21, Indiana 11, Illinois 8, Michigan, 6 Alabama 6, New York 5, and Maryland 4.

*Total consumption of ferrous scrap and pig iron in the United States in 1938, by States and districts*

| State and district | Active plants reporting | Scrap | | | | | | Pig iron | |
|---|---|---|---|---|---|---|---|---|---|
| | | Home | | Purchased | | Total | | | |
| | | Gross tons | Percent of total | Gross tons | Percent of total | Gross tons | Percent of total | Gross tons | Percent of total |
| Connecticut | 67 | 50,528 | 0.4 | 70,900 | 0.7 | 121,428 | 0.6 | 47,746 | 0.3 |
| Maine | 24 | 3,983 | (1) | 3,268 | (1) | 7,251 | (1) | 4,052 | (1) |
| Massachusetts | 119 | 57,265 | .5 | 127,175 | 1.2 | 184,440 | .8 | 59,774 | .3 |
| New Hampshire | 17 | 1,667 | (1) | 1,647 | (1) | 3,314 | (1) | 1,248 | (1) |
| Rhode Island | 15 | 8,703 | .1 | 17,446 | .2 | 26,149 | .1 | 14,362 | .1 |
| Vermont | 15 | 3,161 | (1) | 3,520 | (1) | 6,681 | (1) | 3,019 | (1) |
| Total New England | 257 | 125,307 | 1.1 | 223,956 | 2.2 | 349,263 | 1.6 | 130,201 | .7 |
| Delaware | 9 | 148,316 | 1.3 | 260,221 | 2.6 | 408,537 | 1.9 | 199,944 | 1.1 |
| New Jersey | 95 | | | | | | | | |
| New York | 241 | 493,091 | 4.3 | 478,437 | 4.8 | 971,528 | 4.6 | 927,350 | 5.0 |
| Pennsylvania | 472 | 2,825,244 | 25.0 | 1,911,280 | 19.0 | 4,736,524 | 22.2 | 4,781,482 | 25.8 |
| Total Middle Atlantic | 817 | 3,466,651 | 30.6 | 2,649,938 | 26.4 | 6,116,589 | 28.7 | 5,908,776 | 31.9 |

[1] Less than 0.05 percent.

[3] Senate Hearings, Scrap Iron and Steel: 75th Cong., 1st Sess., S. 2025 and S. J. Res. 180, 63 pp.

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*Total consumption of ferrous scrap and pig iron in the United States in 1938, by States and districts*—Continued

| State and district | Active plants reporting | Scrap | | | | | | Pig iron | |
|---|---|---|---|---|---|---|---|---|---|
| | | Home | | Purchased | | Total | | | |
| | | Gross tons | Percent of total | Gross tons | Percent of total | Gross tons | Percent of total | Gross tons | Percent of total |
| Alabama | 88 | 512,911 | 4.5 | 374,811 | 3.8 | 887,722 | 4.2 | 1,395,369 | 7.5 |
| District of Columbia | 3 | | | | | | | | |
| Kentucky | 26 | 733,041 | 6.5 | 313,458 | 3.1 | 1,046,499 | 4.9 | 1,353,414 | 7.3 |
| Maryland | 33 | | | | | | | | |
| Florida | 17 | 23,278 | .2 | 61,994 | .6 | 85,272 | .4 | 33,965 | .2 |
| Georgia | 50 | | | | | | | | |
| Mississippi | 10 | 421 | (1) | 990 | (1) | 1,411 | (1) | 327 | (1) |
| North Carolina | 45 | 10,200 | .1 | 18,626 | .2 | 28,826 | .1 | 10,929 | .1 |
| South Carolina | 18 | 1,620 | (1) | 2,515 | (1) | 4,135 | (1) | 1,533 | (1) |
| Tennessee | 59 | 81,748 | .7 | 133,192 | 1.3 | 214,940 | 1.0 | 119,626 | .7 |
| Virginia | 63 | | | | | | | | |
| West Virginia | 33 | 213,405 | 1.9 | 339,022 | 3.4 | 552,427 | 2.6 | 501,920 | 2.7 |
| Total Southeastern | 445 | 1,576,624 | 13.9 | 1,244,608 | 12.4 | 2,821,232 | 13.2 | 3,417,083 | 18.5 |
| Arkansas | 17 | | | | | | | | |
| Louisiana | 23 | 11,874 | .1 | 45,168 | .5 | 57,042 | .3 | 1,797 | (1) |
| Oklahoma | 22 | | | | | | | | |
| Texas | 52 | 23,284 | .2 | 53,373 | .5 | 76,657 | .3 | 2,691 | (1) |
| Total Southwestern | 114 | 35,158 | .3 | 98,541 | 1.0 | 133,699 | .6 | 4,488 | (1) |
| Illinois | 230 | 877,793 | 7.8 | 1,001,411 | 10.0 | 1,879,204 | 8.8 | 1,468,762 | 8.0 |
| Indiana | 146 | 1,224,313 | 10.8 | 1,162,971 | 11.6 | 2,387,284 | 11.2 | 1,891,230 | 10.2 |
| Iowa | 62 | 54,391 | .5 | 61,404 | .6 | 115,795 | .6 | 39,214 | .2 |
| Kansas | 40 | 12,075 | .1 | 37,736 | .4 | 49,811 | .2 | 2,529 | (1) |
| Nebraska | 16 | | | | | | | | |
| Michigan | 201 | 1,002,802 | 8.9 | 860,952 | 8.6 | 1,863,754 | 8.7 | 980,742 | 5.3 |
| Wisconsin | 134 | | | | | | | | |
| Minnesota | 69 | 77,946 | .7 | 68,700 | .7 | 146,646 | .7 | 131,618 | .7 |
| Missouri | 71 | 47,220 | .4 | 316,449 | 3.1 | 363,669 | 1.7 | 25,319 | .1 |
| North Dakota | 3 | 1,142 | (1) | 742 | (1) | 1,884 | (1) | | |
| South Dakota | 2 | | | | | | | | |
| Ohio | 359 | 2,529,499 | 22.3 | 1,631,818 | 16.3 | 4,161,317 | 19.5 | 4,274,412 | 23.1 |
| Total North Central | 1,333 | 5,827,181 | 51.5 | 5,142,183 | 51.3 | 10,969,364 | 51.4 | 8,813,826 | 47.6 |
| Arizona | 8 | | | | | | | | |
| Nevada | 4 | 4,889 | (1) | 11,546 | .1 | 16,435 | .1 | 22 | .7 |
| New Mexico | 1 | | | | | | | | |
| Colorado | 26 | 83,353 | .7 | 128,683 | 1.3 | 212,036 | 1.0 | 136,366 | |
| Utah | 15 | | | | | | | | |
| Idaho | 4 | 123 | (1) | 1,611 | (1) | 1,734 | (1) | 2 | |
| Wyoming | 1 | | | | | | | | |
| Montana | 7 | 2,665 | (1) | 2,802 | (1) | 5,467 | (1) | 194 | |
| Total Rocky Mountain | 66 | 91,030 | .8 | 144,642 | 1.5 | 235,672 | 1.1 | 136,584 | .7 |
| Alaska | 1 | | | | | | | | |
| Oregon | 32 | 22,992 | .2 | 80,014 | .8 | 103,006 | .5 | 4,927 | (1) |
| Washington | 63 | | | | | | | | |
| California | 138 | 176,398 | 1.6 | 439,711 | 4.4 | 616,109 | 2.9 | 88,464 | .5 |
| Total Pacific Coast | 234 | 199,390 | 1.8 | 519,725 | 5.2 | 719,115 | 3.4 | 93,391 | .5 |
| Total United States: 1938 | [2] 3,266 | 11,321,341 | 100.0 | 10,023,593 | 100.0 | 21,344,934 | 100.0 | 18,504,349 | 100.0 |
| 1937 | [2] 3,288 | 19,871,033 | | 18,135,239 | | 38,006,272 | | 34,056,527 | |

[1] Less than 0.05 percent.
[2] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.
[3] Revised figures.



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The following table shows the total consumption of ferrous scrap and pig iron by districts and the percentage change in the use of home scrap, purchased scrap, total scrap, and pig iron from 1935 to 1938.

*Consumption of ferrous scrap and pig iron in the United States, 1935–38, by districts*

| District and year | Active plants reporting | Scrap | | | | | | Pig iron | |
|---|---|---|---|---|---|---|---|---|---|
| | | Home | | Purchased | | Total | | | |
| | | Gross tons | Change from previous year, percent | Gross tons | Change from previous year, percent | Gross tons | Change from previous year, percent | Gross tons | Change from previous year, percent |
| New England: | | | | | | | | | |
| 1935 | 232 | 144,408 | (1) | 305,221 | (1) | 449,629 | (1) | 146,656 | (1) |
| 1936 | 238 | 177,305 | +22.8 | 389,315 | +27.6 | 566,620 | +26.0 | 193,703 | +32.1 |
| 1937 | [2] 257 | 233,938 | +31.9 | 401,698 | +3.2 | 635,636 | +12.2 | 239,549 | +23.7 |
| 1938 | 257 | 125,307 | −46.4 | 223,956 | −44.2 | 349,263 | −45.1 | 130,201 | −45.6 |
| Middle Atlantic: | | | | | | | | | |
| 1935 | 770 | 3,803,287 | (1) | 3,201,118 | (1) | 7,004,405 | (1) | 6,445,123 | (1) |
| 1936 | 804 | 5,765,704 | +51.6 | 5,099,929 | +59.3 | 10,865,633 | +55.1 | 10,661,526 | +65.4 |
| 1937 | [2] 825 | 6,516,129 | +13.0 | 5,487,702 | +7.6 | 12,003,831 | +10.5 | 12,681,040 | +18.9 |
| 1938 | 817 | 3,466,651 | −46.8 | 2,649,938 | −51.7 | 6,116,589 | −49.0 | 5,908,776 | −53.4 |
| Southeastern: | | | | | | | | | |
| 1935 | 370 | 1,567,671 | (1) | 1,748,596 | (1) | 3,316,267 | (1) | 2,865,364 | (1) |
| 1936 | 408 | 2,056,519 | +31.2 | 2,026,502 | +15.9 | 4,083,021 | +23.1 | 3,789,654 | +32.3 |
| 1937 | [2] 448 | 2,156,393 | +4.9 | 1,949,704 | −3.8 | 4,106,097 | +.6 | 4,494,498 | +18.6 |
| 1938 | 445 | 1,576,624 | −26.9 | 1,244,608 | −36.2 | 2,821,232 | −31.3 | 3,417,083 | −24.0 |
| Southwestern: | | | | | | | | | |
| 1935 | 98 | 20,922 | (1) | 75,348 | (1) | 96,270 | (1) | 5,010 | (1) |
| 1936 | 104 | 35,326 | +68.8 | 115,289 | +53.0 | 150,615 | +56.5 | 6,972 | +39.2 |
| 1937 | [2] 111 | 51,855 | +46.8 | 147,710 | +28.1 | 199,565 | +32.5 | 23,903 | +242.8 |
| 1938 | 114 | 35,158 | −32.2 | 98,541 | −33.3 | 133,699 | −33.0 | 4,488 | −81.2 |
| North Central: | | | | | | | | | |
| 1935 | 1,144 | 7,490,057 | (1) | 7,161,041 | (1) | 14,651,098 | (1) | 10,875,718 | (1) |
| 1936 | 1,230 | 10,444,433 | +39.4 | 8,874,119 | +23.9 | 19,318,552 | +31.9 | 14,977,899 | +37.7 |
| 1937 | [2] 1,350 | 10,462,393 | +.2 | 9,184,317 | +3.5 | 19,646,710 | +1.7 | 16,086,555 | +7.4 |
| 1938 | 1,333 | 5,827,181 | −44.3 | 5,142,183 | −44.0 | 10,969,364 | −44.2 | 8,813,826 | −45.2 |
| Rocky Mountain: | | | | | | | | | |
| 1935 | 58 | 109,796 | (1) | 125,259 | (1) | 235,055 | (1) | 174,507 | (1) |
| 1936 | 62 | 166,862 | +52.0 | 257,316 | +105.4 | 424,178 | +80.5 | 323,391 | +85.3 |
| 1937 | 66 | 199,056 | +19.3 | 284,825 | +10.7 | 483,881 | +14.1 | 372,213 | +15.1 |
| 1938 | 66 | 91,030 | −54.3 | 144,642 | −49.2 | 235,672 | −51.3 | 136,584 | −63.3 |
| Pacific Coast: | | | | | | | | | |
| 1935 | 193 | 210,611 | (1) | 451,995 | (1) | 662,606 | (1) | 108,085 | (1) |
| 1936 | 217 | 255,240 | +21.2 | 694,274 | +53.6 | 949,514 | +43.3 | 145,489 | +34.6 |
| 1937 | 231 | 251,269 | −1.6 | 679,283 | −2.2 | 930,552 | −2.0 | 158,769 | +9.1 |
| 1938 | 234 | 199,390 | −20.6 | 519,725 | −23.5 | 719,115 | −22.7 | 93,391 | −41.2 |
| United States: | | | | | | | | | |
| 1935 | [3] 2,865 | 13,346,752 | (1) | 13,068,578 | (1) | 26,415,330 | (1) | 20,620,463 | (1) |
| 1936 | [3] 3,063 | 18,901,389 | +41.6 | 17,456,744 | −33.6 | 36,358,133 | +37.6 | 30,098,634 | +46.0 |
| 1937 | [2 3] 3,288 | 19,871,033 | +5.1 | 18,135,239 | +3.9 | 38,006,272 | +4.5 | 34,056,527 | +13.1 |
| 1938 | [3] 3,266 | 11,321,341 | −43.0 | 10,023,593 | −44.7 | 21,344,934 | −43.8 | 18,504,349 | −45.7 |

[1] Canvass began in 1935.
[2] Revised figures.
[3] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

## CONSUMPTION BY TYPE OF FURNACE

*Open-hearth furnaces.*—The total ferrous scrap and pig iron consumed in open hearths was 28,337,001 gross tons in 1938, a decrease of 45 percent from 1937. Of the 1938 total, home scrap comprised 28 percent, purchased scrap 24 percent, and pig iron 48 percent; in 1937 the percentages were 27, 24, and 49, respectively. The use of home scrap decreased 43 percent, purchased scrap 47 percent, and pig iron 45 percent.

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Charges to open-hearth furnaces consisted of 52 percent total scrap and 48 percent pig iron in 1938 compared with 51 and 49 percent, respectively, in 1937. Of the total scrap consumed in open hearths in 1938, 46 percent was purchased scrap compared with 47 percent in 1937 and 48 percent in 1936. Higher proportions of purchased scrap are used in areas remote from pig-iron producing centers. The practice of using scrap exclusively is relatively rare. In 1938 only 4 plants out of a total of 135 operated on a 100-percent-scrap basis; they consumed only 252,737 tons, less than 1 percent of the total consumption of ferrous raw materials in open hearths.

Pennsylvania, the leading steel producer, outranked all other States in 1938 in the consumption of ferrous scrap and pig iron in open hearths, followed by Ohio, Indiana, and Illinois.

*Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1938, by districts and States, in gross tons*

| District and State | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| New England: | | | | | |
| Connecticut | 1 | | | | |
| Massachusetts | 1 | 28,633 | 120,324 | 148,957 | 28,198 |
| Rhode Island | 1 | | | | |
| Total: 1938 | 3 | 28,633 | 120,324 | 148,957 | 28,198 |
| 1937 | 4 | 50,822 | 206,422 | 257,244 | 46,771 |
| Middle Atlantic: | | | | | |
| Delaware | 1 | | | | |
| New Jersey | 1 | 418,412 | 303,422 | 721,834 | 883,199 |
| New York | 7 | | | | |
| Pennsylvania | 49 | 2,341,326 | 1,510,993 | 3,852,319 | 3,976,093 |
| Total: 1938 | 58 | 2,759,738 | 1,814,415 | 4,574,153 | 4,859,292 |
| 1937 | 63 | 5,216,861 | 4,052,345 | 9,269,206 | 10,447,967 |
| Southeastern and Southwestern: | | | | | |
| Alabama | 3 | | | | |
| Georgia | 1 | | | | |
| Tennessee | 1 | 277,456 | 293,844 | 571,300 | 1,051,938 |
| Oklahoma | 1 | | | | |
| District of Columbia | 1 | | | | |
| Kentucky | 2 | | | | |
| Maryland | 1 | 827,205 | 573,008 | 1,400,213 | 1,586,940 |
| West Virginia | 1 | | | | |
| Total: 1938 | 11 | 1,104,661 | 866,852 | 1,971,513 | 2,638,878 |
| 1937 | 12 | 1,495,324 | 1,483,300 | 2,978,624 | 3,376,208 |
| North Central: | | | | | |
| Illinois | 11 | 552,266 | 653,526 | 1,205,792 | 919,396 |
| Indiana | 7 | 1,048,557 | 1,008,554 | 2,057,111 | 1,681,107 |
| Michigan | 3 | 328,901 | 350,984 | 679,885 | 517,406 |
| Iowa | 1 | | | | |
| Missouri | 3 | 10,446 | 206,699 | 217,145 | 4,755 |
| Minnesota | 1 | | | | |
| Wisconsin | 2 | 64,476 | 22,658 | 87,134 | 120,222 |
| Ohio | 28 | 1,883,525 | 1,181,514 | 3,065,039 | 2,785,876 |
| Total: 1938 | 56 | 3,888,171 | 3,423,935 | 7,312,106 | 6,028,762 |
| 1937 | 56 | 6,890,851 | 6,025,704 | 12,916,555 | 10,815,566 |
| Rocky Mountain and Pacific Coast: | | | | | |
| Colorado | 1 | | | | |
| California | 5 | 174,948 | 425,953 | 600,901 | 174,241 |
| Washington | 1 | | | | |
| Total: 1938 | 7 | 174,948 | 425,953 | 600,901 | 174,241 |
| 1937 | 7 | 303,761 | 688,647 | 992,408 | 431,704 |
| Total United States: 1938 | 135 | 7,956,151 | 6,651,479 | 14,607,630 | 13,729,371 |
| 1937 | 142 | 13,957,619 | 12,456,418 | 26,414,037 | 25,118,216 |

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*Bessemer converters.*—The consumption of ferrous scrap and pig iron in bessemer converters totaled 2,061,494 gross tons in 1938, a decrease of 47 percent from 1937. The proportion of scrap consumed in converter practice is low, amounting to only 5.6 percent in 1938, and virtually the entire quantity was home or plant scrap. All the small tonnage of purchased scrap consumed in converters was used in small steel-foundry plants.

Ohio was the principal consumer of scrap in bessemer converters in 1938.

*Consumption of ferrous scrap and pig iron in bessemer converters in the United States in 1938, by districts and States, in gross tons*

| District and State | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| New England and Middle Atlantic: | | | | | |
| Delaware | 1 | | | | |
| Massachusetts | 1 | 717 | 538 | 1,255 | 604 |
| New Jersey | 1 | | | | |
| New York | 1 | | | | |
| Pennsylvania | 7 | 25,242 | 767 | 26,009 | 365,811 |
| Total: 1938 | 11 | 25,959 | 1,305 | 27,264 | 366,415 |
| 1937 | 12 | 46,787 | 3,506 | 50,293 | 881,614 |
| Southeastern and Southwestern: | | | | | |
| Alabama | 1 | | | | |
| Maryland | 1 | | | | |
| West Virginia | 1 | 16,371 | 766 | 17,137 | 129,728 |
| Louisiana | 1 | | | | |
| Total: 1938 | 4 | 16,371 | 766 | 17,137 | 129,728 |
| 1937 | [1] 7 | 24,382 | 1,332 | 25,714 | 262,205 |
| North Central: | | | | | |
| Illinois | 3 | | | | |
| Indiana | 1 | | | | |
| Michigan | 1 | 8,197 | 1,622 | 9,819 | 295,965 |
| Missouri | 1 | | | | |
| Ohio | 5 | 61,224 | 2 | 61,226 | 1,153,940 |
| Total: 1938 | 11 | 69,421 | 1,624 | 71,045 | 1,449,905 |
| 1937 | [1] 11 | 150,291 | 4,205 | 154,496 | 2,544,516 |
| Total United States: 1938 | 26 | 111,751 | 3,695 | 115,446 | 1,946,048 |
| 1937 | [1] 30 | 221,460 | 9,043 | 230,503 | 3,688,335 |

[1] Revised figures.

*Electric steel furnaces.*—Ferrous scrap and pig iron consumed in electric furnaces totaled 951,530 gross tons in 1938, a decrease of 46 percent from 1937. Pig iron comprised less than 2 percent of the total ferrous raw materials used in electric furnaces in 1938. Of the 257 active plants reporting in 1938, 96 operated exclusively on scrap and consumed 201,906 tons, or about 21 percent of the total scrap and pig iron used.

Ohio led all States in consumption of scrap in electric furnaces in 1938, followed by Pennsylvania, Illinois, Michigan, and California.

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*Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1938, by districts and States, in gross tons*

| District and State | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| New England: | | | | | |
| Connecticut | 4 | | | | |
| New Hampshire | 1 | 4,462 | 3,325 | 7,787 | 346 |
| Rhode Island | 1 | | | | |
| Massachusetts | 7 | 2,831 | 4,708 | 7,539 | 32 |
| Total: 1938 | 13 | 7,293 | 8,033 | 15,326 | 378 |
| 1937 | 13 | 15,579 | 12,727 | 28,306 | 2,336 |
| Middle Atlantic: | | | | | |
| Delaware | 1 | | | | |
| New Jersey | 4 | 9,827 | 17,981 | 27,808 | 248 |
| New York | 19 | 18,292 | 22,059 | 40,351 | 1,162 |
| Pennsylvania | 49 | 97,811 | 91,532 | 189,343 | 2,874 |
| Total: 1938 | 73 | 125,930 | 131,572 | 257,502 | 4,284 |
| 1937 | [1] 75 | 204,396 | 228,676 | 433,072 | 10,791 |
| Southeastern: | | | | | |
| District of Columbia | 1 | | | | |
| Maryland | 2 | 6,042 | 6,110 | 12,152 | 227 |
| West Virginia | 1 | | | | |
| Alabama | 2 | | | | |
| Florida | 1 | 3,075 | 7,241 | 10,316 | 4 |
| Georgia | 1 | | | | |
| Tennessee | 1 | | | | |
| Virginia | 3 | 5,245 | 2,612 | 7,857 | 111 |
| Total: 1938 | 12 | 14,362 | 15,963 | 30,325 | 342 |
| 1937 | [1] 11 | 14,690 | 25,240 | 39,930 | 251 |
| Southwestern: | | | | | |
| Arkansas | 1 | | | | |
| Oklahoma | 1 | 3,456 | 5,036 | 8,492 | 144 |
| Louisiana | 3 | | | | |
| Texas | 5 | 11,613 | 6,896 | 18,509 | 48 |
| Total: 1938 | 10 | 15,069 | 11,932 | 27,001 | 192 |
| 1937 [2] | 12 | 22,616 | 21,076 | 43,692 | 235 |
| North Central: | | | | | |
| Illinois | 18 | 40,485 | 74,472 | 114,957 | 1,461 |
| Indiana | 10 | 8,645 | 24,880 | 34,525 | 260 |
| Iowa | 1 | | | | |
| Kansas | 1 | 2,179 | 3,669 | 5,848 | 47 |
| Nebraska | 1 | | | | |
| Michigan | 21 | 58,300 | 40,540 | 98,840 | 5,717 |
| Minnesota | 3 | 2,005 | 908 | 2,913 | 49 |
| Missouri | 10 | 3,903 | 5,033 | 8,936 | 474 |
| Ohio | 25 | 121,103 | 95,146 | 216,249 | 1,193 |
| Wisconsin | 14 | 18,724 | 20,530 | 39,254 | 741 |
| Total: 1938 | 104 | 256,344 | 265,178 | 521,522 | 9,942 |
| 1937 | [1] 105 | 523,102 | 547,633 | 1,070,735 | 30,194 |
| Rocky Mountain: | | | | | |
| Arizona | 2 | | | | |
| Colorado | 2 | 4,735 | 6,068 | 10,803 | ---------- |
| Nevada | 1 | | | | |
| Utah | 1 | | | | |
| Total: 1938 | 6 | 4,735 | 6,068 | 10,803 | ---------- |
| 1937 | 7 | 7,827 | 7,333 | 15,160 | ---------- |
| Pacific Coast: | | | | | |
| Alaska | 1 | | | | |
| Oregon | 3 | 2,624 | 4,554 | 7,178 | 10 |
| California | 22 | 22,484 | 21,592 | 44,076 | 713 |
| Washington | 13 | 4,515 | 17,389 | 21,904 | 32 |
| Total: 1938 | 39 | 29,623 | 43,535 | 73,158 | 755 |
| 1937 | [1] 45 | 38,847 | 56,080 | 94,927 | 908 |
| Total United States: 1938 | 257 | 453,356 | 482,281 | 935,637 | 15,893 |
| 1937 [2] | [1] 268 | 827,057 | 898,765 | 1,725,822 | 44,715 |

[1] Revised figures.
[2] Revised to include 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron from Texas previously included under cupola furnaces.

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*Cupola furnaces.*—Consumption of ferrous scrap and pig iron in cupola furnaces in 1938 totaled 6,596,539 gross tons, a decrease of 38 percent from 1937. Use of home scrap decreased 40 percent, purchased scrap 32 percent, total scrap 36 percent, and pig iron 43 percent. Thus the proportion of purchased scrap more than held its own; however, the relatively low price of scrap compared with pig iron was undoubtedly an important factor.

Charges to cupola furnaces in 1938 contained 26 percent home scrap, 37 percent purchased scrap, and 37 percent pig iron; in 1937 the percentages were 27, 34, and 39, respectively. Many cupola plants operate on 100-percent scrap charge, and 421 plants reported the consumption of 595,090 gross tons of ferrous scrap without the use of pig iron in 1938.

Michigan continued as the principal consumer of scrap in cupola furnaces in 1938, but the position of other States changed; Ohio, Pennsylvania, Illinois, and New York followed in decreasing order.

*Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1938, by districts and States, in gross tons*

| District and State | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| New England: | | | | | |
| Connecticut | 53 | 32,828 | 23,021 | 55,849 | 32,566 |
| Maine | 23 | 3,906 | 3,268 | 7,174 | 4,052 |
| Massachusetts | 104 | 31,163 | 54,018 | 85,181 | 40,784 |
| New Hampshire | 15 | 868 | 1,647 | 2,515 | 998 |
| Rhode Island | 12 | 4,261 | 5,102 | 9,363 | 7,275 |
| Vermont | 15 | 3,161 | 3,520 | 6,681 | 3,019 |
| Total: 1938 | 222 | 76,187 | 90,576 | 166,763 | 88,694 |
| 1937 | [1] 223 | 132,962 | 159,608 | 292,570 | 165,608 |
| Middle Atlantic: | | | | | |
| Delaware | 5 | 803 | 1,398 | 2,201 | 983 |
| New Jersey | 83 | 51,709 | 179,172 | 230,881 | 116,058 |
| New York | 194 | 94,696 | 182,529 | 277,225 | 109,608 |
| Pennsylvania | 315 | 159,324 | 237,628 | 396,952 | 307,165 |
| Total: 1938 | 597 | 306,532 | 600,727 | 907,259 | 533,814 |
| 1937 | 597 | 483,990 | 849,963 | 1,333,953 | 947,345 |
| Southeastern: | | | | | |
| Alabama | 75 | 97,349 | 108,845 | 206,194 | 360,322 |
| District of Columbia | 1 | 20,810 | 22,495 | 43,305 | 23,239 |
| Maryland | 27 | | | | |
| Florida | 16 | 832 | 2,585 | 3,417 | 452 |
| Georgia | 48 | 10,571 | 15,196 | 25,767 | 16,838 |
| Kentucky | 22 | 15,441 | 13,016 | 28,457 | 34,304 |
| Mississippi | 10 | 421 | 990 | 1,411 | 327 |
| North Carolina | 45 | 10,200 | 18,626 | 28,826 | 10,929 |
| South Carolina | 18 | 1,620 | 2,515 | 4,135 | 1,533 |
| Tennessee | 56 | 57,296 | 65,610 | 122,906 | 83,689 |
| Virginia | 58 | 18,695 | 59,672 | 78,367 | 35,606 |
| West Virginia | 26 | 6,181 | 18,986 | 25,167 | 77,029 |
| Total: 1938 | 402 | 239,416 | 328,536 | 567,952 | 644,268 |
| 1937 | [1] 404 | [2] 345,650 | [2] 371,569 | [2] 717,219 | [2] 847,191 |
| Southwestern: | | | | | |
| Arkansas | 16 | 625 | 3,218 | 3,843 | 154 |
| Louisiana | 19 | 5,274 | 14,510 | 19,784 | 875 |
| Oklahoma | 20 | 1,981 | 4,989 | 6,970 | 414 |
| Texas | 47 | 11,671 | 46,477 | 58,148 | 2,643 |
| Total: 1938 | 102 | 19,551 | 69,194 | 88,745 | 4,086 |
| 1937 | 96 | [1] 28,169 | [2] 100,527 | [2] 128,696 | [1] 23,243 |

See footnotes at end of table.

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*Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1938, by districts and States, in gross tons*—Continued

| District and State | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| North Central: | | | | | |
| Illinois | 177 | 161,104 | 228,168 | 389,272 | 275,273 |
| Indiana | 112 | 78,501 | 109,248 | 187,749 | 75,029 |
| Iowa | 58 | 51,076 | 56,781 | 107,857 | 35,940 |
| Kansas | 38 | 8,928 | 29,578 | 38,506 | 1,599 |
| Michigan | 163 | 372,778 | 279,428 | 652,206 | 327,484 |
| Minnesota | 63 | 13,628 | 49,419 | 63,047 | 12,839 |
| Missouri | 56 | 30,536 | 105,976 | 136,512 | 18,815 |
| Nebraska | 15 | 1,810 | 5,951 | 7,761 | 922 |
| North Dakota | 3 | 1,142 | 742 | 1,884 | |
| South Dakota | 2 | | | | |
| Ohio | 250 | 175,008 | 225,552 | 400,560 | 233,016 |
| Wisconsin | 108 | 133,126 | 82,712 | 215,838 | 98,634 |
| Total: 1938 | 1,045 | 1,027,637 | 1,173,555 | 2,201,192 | 1,079,551 |
| 1937 | [1] 1,057 | 1,798,030 | 1,936,927 | 3,734,957 | 2,115,595 |
| Rocky Mountain: | | | | | |
| Arizona | 6 | 2,299 | 8,719 | 11,018 | |
| Colorado | 21 | 7,205 | 18,379 | 25,584 | 7,948 |
| Idaho | 4 | 118 | 1,611 | 1,729 | |
| Montana | 7 | 2,665 | 2,802 | 5,467 | 194 |
| Nevada | 3 | | | | |
| New Mexico | 1 | 268 | 30 | 298 | 24 |
| Wyoming | 1 | | | | |
| Utah | 13 | 7,306 | 19,819 | 27,125 | 14,020 |
| Total: 1938 | 56 | 19,861 | 51,360 | 71,221 | 22,186 |
| 1937 | 55 | 30,903 | 81,243 | 112,146 | 37,845 |
| Pacific Coast: | | | | | |
| California | 109 | 44,059 | 117,622 | 161,681 | 28,544 |
| Oregon | 29 | 2,389 | 6,217 | 8,606 | 1,920 |
| Washington | 49 | 5,056 | 13,427 | 18,483 | 1,574 |
| Total: 1938 | 187 | 51,504 | 137,266 | 188,770 | 32,038 |
| 1937 | [1] 179 | 58,691 | 129,241 | 187,932 | 58,407 |
| Total United States: 1938 | 2,611 | 1,740,688 | 2,451,214 | 4,191,902 | [2] 2,404,637 |
| 1937 | [1] 2,611 | [2] 2,878,395 | [2] 3,629,078 | [2] 6,507,473 | [2][3] 4,195,234 |

[1] Revised figures.
[2] Revised to include 12,180 and 634 tons of home scrap, 1,930 and 457 tons of purchased scrap, and 58,497 and 472 tons of pig iron in West Virginia and Texas previously included under air furnaces and to exclude 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron from Texas now included under electric furnaces.
[3] Includes some pig iron used in making direct castings.

*Air furnaces.*—Ferrous scrap and pig iron consumed in air furnaces amounted to 610,726 gross tons in 1938, a decrease of 49 percent from 1937. The use of both home and purchased scrap decreased 43 percent and that of pig iron 58 percent. Thus, equipment of this type used relatively less pig iron than purchased scrap in 1938. Only six operators of air furnaces reported exclusive use of scrap in 1938, the quantity consumed amounting to 112,554 tons.

Ohio led in scrap consumption in air furnaces in 1938, followed by Indiana, Illinois, Wisconsin, and Pennsylvania.

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*Consumption of ferrous scrap and pig iron in air furnaces[1] in the United States in 1938, by districts and States, in gross tons*

| District and State | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| New England: | | | | | |
| Connecticut | 7 | 7,317 | 2,037 | 9,354 | 6,484 |
| Massachusetts | 3 | | | | |
| New Hampshire | 1 | 5,359 | 2,344 | 7,703 | 6,070 |
| Rhode Island | 1 | | | | |
| Total: 1938 | 12 | 12,676 | 4,381 | 17,057 | 12,554 |
| 1937 | [2] 11 | 28,829 | 10,068 | 38,897 | 24,681 |
| Middle Atlantic: | | | | | |
| Delaware | 1 | 4,534 | 1,329 | 5,863 | 4,119 |
| New Jersey | 3 | | | | |
| New York | 11 | 13,951 | 6,004 | 19,955 | 10,586 |
| Pennsylvania | 21 | 23,554 | 14,465 | 38,019 | 27,403 |
| Total: 1938 | 36 | 42,039 | 21,798 | 63,837 | 42,108 |
| 1937 | 36 | 108,778 | 47,238 | 156,016 | 103,518 |
| Southeastern: | | | | | |
| Virginia | 1 | 2,109 | 5,251 | 7,360 | 2,077 |
| West Virginia | 2 | | | | |
| Total: 1938 | 3 | 2,109 | 5,251 | 7,360 | 2,077 |
| 1937 [3] | 3 | 3,211 | 4,167 | 7,378 | 5,068 |
| North Central: | | | | | |
| Illinois | 13 | 44,709 | 17,132 | 61,841 | 39,049 |
| Indiana | 11 | 59,589 | 13,514 | 73,103 | 19,924 |
| Michigan | 8 | 19,296 | 11,181 | 30,477 | 17,108 |
| Iowa | 1 | | | | |
| Minnesota | 1 | 4,854 | 2,059 | 6,913 | 5,965 |
| Missouri | 1 | | | | |
| Ohio | 23 | 83,503 | 33,456 | 116,959 | 35,279 |
| Wisconsin | 10 | 24,814 | 21,841 | 46,655 | 10,695 |
| Total: 1938 | 68 | 236,765 | 99,183 | 335,948 | 128,020 |
| 1937 | [2] 70 | 370,925 | 169,054 | 539,979 | 309,603 |
| Rocky Mountain and Pacific Coast: | | | | | |
| Colorado | 1 | 825 | 185 | 1,010 | 755 |
| California | 2 | | | | |
| Total: 1938 | 3 | 825 | 185 | 1,010 | 755 |
| 1937 | 3 | 1,332 | 694 | 2,026 | 2,118 |
| Total United States: 1938 [1] | 122 | 294,414 | 130,798 | 425,212 | 185,514 |
| 1937 [1] [2] | [2] 123 | 513,075 | 231,221 | 744,296 | 444,988 |

[1] Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio in 1938, and 1 each in Michigan and Ohio in 1937.
[2] Revised figures.
[3] Revised to exclude 12,180 and 634 tons of home scrap, 1,930 and 457 tons of purchased scrap, and 58,497 and 472 tons of pig iron in West Virginia and Texas now included under cupola furnaces.

*Crucible and puddling furnaces.*—Crucible and puddling furnaces, whose combined output of iron and steel is very small, consume only minor quantities of ferrous raw materials, as the following table shows.

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*Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1938, by districts and States, in gross tons*

| District and State | Active plants reporting | Scrap | | | Pig iron |
|---|---|---|---|---|---|
| | | Home | Purchased | Total | |
| New England: | | | | | |
| Connecticut | 2 | | | | |
| Maine | 1 | 219 | 416 | 635 | 142 |
| Massachusetts | 3 | | | | |
| Total: 1938 | 6 | 219 | 416 | 635 | 142 |
| 1937 | 4 | 507 | 525 | 1,032 | 1 |
| Middle Atlantic: | | | | | |
| New Jersey | 3 | | | | |
| New York | 2 | 259 | 295 | 554 | 513 |
| Pennsylvania | 8 | 524 | 1,827 | 2,351 | 2,856 |
| Total: 1938 | 13 | 783 | 2,122 | 2,905 | 3,369 |
| 1937 | 9 | 3,311 | 3,865 | 7,176 | 27,494 |
| Southeastern and North Central: | | | | | |
| Kentucky | 1 | | | | |
| Maryland | 1 | | | | |
| Virginia | 1 | 106 | 1,003 | 1,109 | 2,003 |
| Indiana | 1 | | | | |
| Kansas | 1 | | | | |
| Ohio | 5 | 41 | 7 | 48 | 47 |
| Total: 1938 | 10 | 147 | 1,010 | 1,157 | 2,050 |
| 1937 | 7 | 1,548 | 2,810 | 4,358 | 4,037 |
| Total United States: 1938 | 29 | 1,149 | 3,548 | 4,697 | 5,561 |
| 1937 | 20 | 5,366 | 7,200 | 12,566 | 31,532 |

*Blast furnaces.*—Ferrous scrap constitutes only a small proportion of the metal-bearing materials consumed in blast furnaces. The other materials used in 1938 were 32,373,834 gross tons of iron and manganiferous iron ores, 2,271,055 tons of cinder and scale, and 951,000 tons of flue dust. Total consumption of scrap in 1938, as reported by 71 plants operating blast furnaces, was 1,064,410 tons, a decrease of 55 percent from 1937. Of the 1938 total, 72 percent was home scrap and 28 percent purchased scrap.

The proportion of scrap used in blast furnaces again declined in 1938, amounting to 5.7 percent of the pig iron produced in 1938 compared with 6.6 percent in 1937 and 6.9 percent in 1936. Purchased scrap was equivalent to 1.6 percent of the pig iron produced in 1938 compared with 2.5 percent in 1937 and 3.0 percent in 1936.

Blast furnaces in Ohio continued to consume more scrap in 1938 than those in any other State.

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*Consumption of ferrous scrap in blast furnaces in the United States in 1938, by districts and States, in gross tons*

| District and State | Active plants reporting | Scrap | | |
|---|---|---|---|---|
| | | Home | Purchased | Total |
| Middle Atlantic: | | | | |
| New York | 6 | 28,506 | 24,157 | 52,663 |
| Pennsylvania | 18 | 177,463 | 54,068 | 231,531 |
| Total: 1938 | 24 | 205,969 | 78,225 | 284,194 |
| 1937 | 30 | 457,245 | 314,457 | 771,702 |
| Southeastern: | | | | |
| Alabama | 7 | 147,513 | 26,867 | 174,380 |
| Kentucky | 1 | | 8,112 | 8,112 |
| Maryland | 1 | 39,644 | 8,458 | 48,102 |
| Tennessee | 1 | | 216 | 216 |
| West Virginia | 2 | 12,984 | | 12,984 |
| Total: 1938 | 12 | 200,141 | 43,653 | 243,794 |
| 1937 | 13 | 272,713 | 87,401 | 360,114 |
| North Central: | | | | |
| Illinois | 5 | 78,426 | 27,341 | 105,767 |
| Indiana | 3 | 20,694 | 6,774 | 27,468 |
| Iowa | 1 | | 700 | 700 |
| Michigan | 5 | 39,898 | 47,646 | 87,544 |
| Minnesota | 1 | 4,685 | 98 | 4,783 |
| Ohio | 18 | 205,095 | 96,141 | 301,236 |
| Total: 1938 | 33 | 348,798 | 178,700 | 527,498 |
| 1937 | 36 | 729,139 | 500,786 | 1,229,925 |
| Rocky Mountain: | | | | |
| Colorado | 1 | 8,924 | | 8,924 |
| Utah | 1 | | | |
| Total: 1938 | 2 | 8,924 | | 8,924 |
| 1937 | 2 | 8,964 | 870 | 9,834 |
| Total United States: 1938 | 71 | 763,832 | 300,578 | 1,064,410 |
| 1937 | 81 | 1,468,061 | 903,514 | 2,371,575 |

## FOREIGN TRADE [4]

*Imports.*—Imports of iron and steel scrap into the United States, which are not of any great significance, amounted to 24,451 gross tons valued at $281,240 in 1938 compared with 81,640 tons valued at $1,153,206 in 1937. In addition, 10,444 tons of tin-plate scrap were imported in 1937, largely from Canada; 1938 receipts totaled 12,916 tons.

*Exports.*—Ferrous-scrap exports (all types) from the United States continued on a large scale in 1938. However, the tonnage and value decreased sharply from the record shipments of 1937. A total of 2,998,607 gross tons, valued at $45,833,916, was exported in 1938 compared with 4,101,549 tons, valued at $79,387,459, in 1937. The shipments included 24,216 tons of tin-plate scrap, waste-waste, strips, cobbles, etc., valued at $902,607 in 1938 compared with 53,447 tons, valued at $2,824,293, in 1937. The following table shows the principal countries to which shipments of scrap were consigned during the 5-year period, 1934–38.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Ferrous scrap exported from the United States, 1934–38, by countries, in gross tons*

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Canada | 54,484 | 96,128 | 63,712 | 185,571 | 92,217 |
| Germany | 10,882 | 4,113 | 6,799 | 88,153 | 230,903 |
| Italy | 225,644 | 382,775 | 285,126 | 381,394 | 434,717 |
| Japan | 1,168,496 | 1,117,973 | 1,057,621 | 1,911,508 | 1,381,801 |
| Netherlands | 6,897 | 9,055 | 4,777 | 143,401 | 206,570 |
| Poland | 123,736 | 36,627 | 31,104 | 275,607 | 151,451 |
| United Kingdom | 134,434 | 277,366 | 364,874 | 847,177 | 387,347 |
| Other countries | 110,597 | 179,922 | 122,119 | 268,738 | 113,601 |
| Total value | 1,835,170 | 2,103,959 | 1,936,132 | 4,101,549 | 2,998,607 |
| | $19,187,858 | $22,949,070 | $24,684,084 | $79,387,459 | $45,833,916 |

Of the total exports of ferrous scrap from the United States in 1938, 1,769,611 gross tons cleared through customs districts on the Atlantic coast (2,221,689 tons in 1937), 779,613 tons from districts bordering the Gulf of Mexico (1,389,828 tons in 1937), 368,842 tons from districts along the Pacific coast (342,707 tons in 1937), and 80,541 tons from other customs districts (147,325 tons in 1937).

Exports have been drawn largely from seaboard areas where the cost of transportation from the point of origin to the port of exportation is relatively low and where the cost of transportation to domestic iron and steel plants not within the area is often prohibitive.

## WORLD ASPECTS

The great demand for scrap in steel-making in recent years has encouraged the intensive reclamation of scrap in all countries. In fact, several countries, including Germany, the United Kingdom, Japan, and Italy, have officially sanctioned campaigns to encourage the collection and utilization of scrap from all possible sources.

World requirements of scrap abated somewhat in 1938 because of a slowing down of steel production. According to Metal Statistics world production of steel ingots totaled 107,000,000 gross tons in 1938, a drop of 19 percent from the 132,500,000-ton record of 1937. The greater part of this decrease, however, occurred in the United States, and if this country is excluded world production fell only 4 percent from the 1937 levels.

In countries seeking self-sufficiency every effort is being made to increase the production of pig iron from domestic raw materials and thereby reduce the proportions of scrap used in steel-furnace charges. However, demand for steel has exceeded the growth of pig-iron production, with the result that scrap has been imported by these countries in ever-increasing quantities.

*Cartel activities.*—On March 11, 1937, producers of steel in 10 European countries organized a scrap-buying cartel for the purpose of purchasing and distributing scrap moving in international trade. Cartel members agree to buy all foreign scrap through the cartel's representative, the British Iron and Steel Federation in London. According to a report [5] the cartel bought 1,468,000 gross tons of scrap from the United States in 1938 and then divided the tonnage among its members. Italy, the leading European scrap importer, and the United Kingdom have taken much the largest part of the cartel's purchases.

[5] Daily Metal Reporter, vol. 39, No. 44, Mar. 8, 1939, pp. 1, 10.

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Early in 1938 the Seiko Genryo Kowakai (Steel Materials Conference) decided upon a purchasing policy for the last half of 1938.[6] It was agreed that when steel makers who are not members of the conference desire to purchase scrap iron and scrap steel from the United States, specified as the major source of imports for Japan, such purchases should be entrusted to the conference which will make the purchase through its specified agent, Rokuyokai.

## REVIEW BY COUNTRIES

*Germany.*—From 1930 to 1932, inclusive, Germany exported scrap iron and scrap steel but since then has imported it, taking larger quantities each year. Efforts have been made to conserve domestic scrap by increasing the amount of pig iron used in steel-making furnaces, and the drive for self-sufficiency has centered largely on the subsidized development of low-grade iron ores, inasmuch as Germany at present produces only about 50 percent of the ferrous raw materials, including scrap, required by its industry.[7] In 1938, partly owing to the acquisition of Austria and the Sudetenland from Czechoslovakia, Germany for the third successive year established a new record in steel production, by which that nation ranks second to the United States. However, the annexation of Austria and the Sudetenland has not enhanced Germany's position particularly, as the annual production of these territories is relatively small and in the past both have imported ferrous raw materials. Extensive propaganda to arouse the public to an understanding of the value of old materials has been decidedly successful. German municipalities having a population of more than 35,000 are obliged to sort and salvage old materials from refuse.

*Italy.*—In 1938 Italy regained its position among European nations as the largest importer of scrap iron and scrap steel from the United States, this country having supplied 66 percent of the total Italian imports in that year. Scrap is the principal ferrous raw material imported into Italy. Italian iron mines produce only about 35 percent of the requirements of the steel industry, and the rest is supplied largely by scrap imported from the United States and France and by domestic scrap. Application of sanctions against Italy in 1935 acted as an incentive toward greater self-sufficiency; and scrap imports, which exceeded 1 million tons in 1935, were reduced to less than one-half that figure by the end of 1938.[8]

*Japan.*—The production of steel ingots and castings in Japan has more than doubled since 1932, and the demand for ferrous raw materials has increased correspondingly. Pig-iron production has been expanded to meet part of the requirements; however, the proportions of scrap used in furnace charges also have increased, and imports of scrap iron and scrap steel are essential to the maintenance of the present steel-making rate. Early in 1938 the Japanese Department of Finance considered restricting imports of scrap and pig iron in order to balance the country's international account and tentatively set 1938 imports at one-half the 1937 total; thus the 1938 imports of scrap

[6] The Iron Age, vol. 141, No. 11, Mar. 17, 1938, p. 93–C.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, pp. 8, 9.
[8] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, pp. 11, 12.

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would amount to about 1,500,000 metric tons.[9] Japanese military successes in China stabilized her credit in the fall of 1938. As a result, large orders for scrap iron and scrap steel were immediately placed with foreign suppliers. The United States is by far the leading source of imports of scrap into Japan. Heavy European demand and embargoes on exports of scrap in countries from which stocks might otherwise have been obtained have increased the share supplied by the United States. No other country has furnished Japan with as much as 10 percent of its total imports of scrap in recent years.

*Poland.*—In recent years the trend in Poland has been toward increasing the proportion of domestically produced pig iron used in steel making and thus minimizing the necessity of importing large tonnages of scrap iron and scrap steel. In 1938 imports of scrap dropped to approximately 390,000 gross tons, or 28 percent below the 1937 imports of 540,000 tons.[10] Expansion of blast-furnace capacity in Poland, as well as acquisition of the Trans-Olzan area from Czechoslovakia, is largely responsible for the reduction in Poland's imports of scrap. The addition of the Trans-Olzan area will increase Poland's annual pig-iron production by 500,000 tons or 55 percent and her steel output by 750,000 tons or 50 percent, thus satisfying Poland's most pressing need of steel for national defense.[11]

*United Kingdom.*—Abnormally large stocks of imported scrap iron and scrap steel on hand and on order in the United Kingdom in 1937, when demand for finished steel products suddenly disappeared, resulted in a sharp decrease of imports in 1938. The oversupplies, purchased largely in 1937, impeded the progress of domestic collectors of scrap in 1938 and brought severe censure of the British Iron and Steel Federation.[12] To meet the distress of the scrap merchants it was suggested that the British steel trade should stock all offered tonnages of home-collected scrap material to keep conditions fluid for the scrap industry.[13] Export restrictions, agreed upon by the scrap and steel industries in 1937, were removed, but the export prices placed much of the business out of reach of British merchants. However, special arrangements were made to sell surplus material to foreign buyers, and exports increased during the closing months of 1938.

[9] Daily Metal Reporter, vol. 38, No. 42, Mar. 2, 1938, p. 10.
[10] Waste Trade Journal, vol. 67, No. 1, Apr. 15, 1939, p. 15.
[11] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, pp. 12, 13.
[12] The Iron and Steel Trades in 1938: Wm. Jacks & Co., Special Review, London, p. 21.
[13] American Metal Market, vol. 45, No. 174, Sept. 8, 1938, p. 5.

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# IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL

By ROBERT H. RIDGWAY AND H. W. DAVIS [1]

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World production of iron and steel in 1938 receded from the record established in 1937 but was still at a high level. Although the total world figure shows the effects of this drop, the bulk of the decline took place in the United States. Foreign producers, stimulated by war conditions, heavy armament activities, and frantic attempts at national self-sufficiency, continued operations on a scale that was, in general, only slightly below the record levels of 1937; in fact, new production peaks were established in some countries, notably Germany, Italy, Japan, and the U. S. S. R. Some of the gain in Germany was due to territorial accession during 1938, but production in that country even as formerly constituted advanced. Output in Belgium, France, and Great Britain was off in 1938. World output of pig iron and steel each fell 20 percent in 1938 compared with 1937; American production dropped 48 and 44 percent, respectively, and the rest of the world only 4 and 5 percent. Of the total world putput of pig iron and steel in 1938 the United States furnished about 24 and 27 percent, respectively—the lowest proportionate share in more than half a century.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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*Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value |
| Iron ore: | | | | |
| Production by— | | | | |
| Districts: | | | | |
| Lake Superior | [1] 61,657,635 | [2] | 21,308,410 | [2] |
| Southeastern | 6,351,053 | | 4,325,729 | |
| Northeastern | 3,145,177 | | 2,306,910 | |
| Western | 939,683 | | 506,233 | |
| | 72,093,548 | [2] | 28,447,282 | [2] |
| Mining methods: | | | | |
| Open pit | [3] 48,632,193 | [2] | [3] 14,530,755 | [2] |
| Underground | [3] 23,461,355 | | [3] 13,916,527 | |
| | 72,093,548 | [2] | 28,447,282 | [2] |
| Varieties: | | | | |
| Hematite | [4] 68,072,781 | [2] | [4 5] 25,607,467 | [2] |
| Brown ore | [6] 666,374 | | 363,146 | |
| Magnetite | [4 6] 3,353,861 | | [4 5] 2,476,221 | |
| Carbonate | 532 | | 448 | |
| | 72,093,548 | [2] | 28,447,282 | [2] |
| Shipments (exclusive of ore for paint) | 72,347,785 | $207,828,213 | 26,430,910 | $74,322,405 |
| Average value per ton at mine | | 2.87 | | 2.81 |
| Stocks at mines Dec. 31 | 5,526,564 | [2] | 7,611,048 | [2] |
| Imports | 2,442,069 | 5,841,637 | 2,122,455 | 5,288,195 |
| Exports | 1,264,102 | 4,039,248 | 591,524 | 1,954,287 |
| Pig iron: | | | | |
| Production | 36,145,095 | [2] | 18,582,322 | [2] |
| Shipments | 35,224,347 | 731,139,435 | 18,202,354 | 356,875,369 |
| Average value per ton at furnaces | | 20.76 | | 19.61 |
| Imports | 111,697 | 1,701,304 | 30,400 | 598,461 |
| Exports | 782,436 | 19,403,285 | 432,851 | 7,135,129 |
| Ferro-alloys: | | | | |
| Production | 1,008,170 | [2] | 584,724 | [2] |
| Shipments: | | | | |
| Ferromanganese | 359,842 | 30,696,748 | 223,720 | 19,144,884 |
| Spiegeleisen | 134,983 | 3,969,822 | 24,939 | 80,830 |
| Ferrosilicon | 362,313 | 17,683,900 | 163,775 | 7,999,661 |
| Other varieties | 113,513 | 33,790,022 | 51,678 | 14,586,138 |
| | 970,651 | 86,140,492 | 464,112 | 41,811,513 |
| Imports: | | | | |
| Ferromanganese | 29,558 | 2,163,616 | 26,258 | 1,770,948 |
| Spiegeleisen | 16,841 | 589,766 | 17,248 | 625,480 |
| Ferrosilicon | 12,930 | 349,207 | 5,325 | 134,067 |
| Steel production: | | | | |
| Open hearth: | | | | |
| Basic | 45,772,510 | [2] | 25,691,963 | [2] |
| Acid | 499,793 | | 272,337 | |
| Bessemer | 3,449,927 | | 1,880,661 | |
| Crucible | 934 | | 6 | |
| Electric | 845,537 | | 505,024 | |
| | 50,568,701 | [2] | 28,349,991 | [2] |

[1] Includes a small quantity of ore produced in southern Wisconsin.
[2] Figures not available.
[3] Some underground included with open pit.
[4] Small quantity of hematite included with magnetite.
[5] Small quantity of magnetite included with hematite.
[6] Small quantity of brown ore included with magnetite.

The domestic iron and steel industry in 1938 followed a pattern almost the reverse of that in 1937, and production was at a low level. As a result of sharply curtailed operations in the last quarter of 1937, the year opened with a low operating rate which persisted during the first 6 months. There was some improvement throughout the last half of the year, but the ground lost in 1937 was not regained. The

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peak production was attained in November, when 62 percent of the steel capacity was employed compared with 90 percent in April, the peak month of 1937. At the close of 1938 operations were definitely on a larger scale than during the opening months; the average rate of production in the last quarter was 56 percent compared with 32 percent in the first quarter. The average operating rate for 1938 was 40 percent of capacity compared with 72 percent in 1937. The producers of such mineral products as iron ore, manganiferous iron ore, fluorspar, fluxing stone, and coke, which depend on iron and steel furnaces for their chief market, felt the lower demand in 1938. Domestic production of iron ore, the principal raw material, decreased 61 percent from 1937, was 56 percent below the 1925–29 average, and was the lowest since 1934. Figure 1 shows the trends in domestic production of iron ore, pig iron, and steel for more than half a century.

Although production of automobiles dropped 48 percent from 1937 to 2,489,635 units in 1938, the automotive

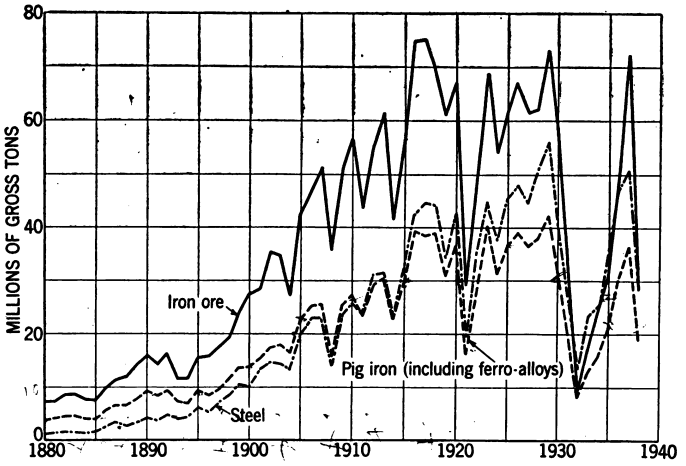


FIGURE 1.—Trends in production of iron ore, pig iron, and steel in the United States, 1880–1938.

industry remained the chief consuming outlet for steel, taking about one-sixth of the total. Agriculture had a good year, but prices of farm products were lower, resulting in an actual and relative decline in the quantity of steel moving into this outlet. Steel exported, though lower than in 1937, held up well and was more than double the quantity moving into agriculture. The relative quantities of steel used in containers were about the same in 1938 as in 1937.

The capital-goods industries continued the slump that began during the last quarter of 1937, less steel being demanded from this outlet. In periods of slack business activity, when large volumes of plant and equipment are idle, there is little incentive to expand existing facilities. Buying by the railroads was curtailed further by the drop in earnings during the year, particularly during the first two quarters, and purchases of all materials and equipment were more than 50 percent less than in 1937. New lightweight rolling stock designed for higher speeds has featured the railroad demand in recent years. Although this trend is more evident in the passenger branch, where high-speed,



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streamlined trains are being featured, it also applies to freight-moving equipment.

The construction industry experienced a better year in 1938 than in 1937, resulting in a larger consumption of steel. Public construction expenditures, which increased during the latter part of 1938, more than made up for the recession in private construction, reversing the condition in 1937. There was a decided slump in industrial building in 1938, and commercial building construction dropped about 6 percent. Despite the increase in 1938 the industry was far below predepression levels.

Reversing the trend of recent years, the price of steel was reduced materially in 1938 (see fig. 2); large inventories and low demand accounted for the decline. Price reductions during the year on nearly all steel products brought down the composite price of finished steel, as compiled by Iron Age, to 2.255 cents per pound in October from 2.512 cents at the beginning of the year; for November and December the figure was 2.286 cents. The average for the year was 2.394 cents, the highest in any year since 1924, except 1937. Changes in the basing point system in 1938, including abandonment of the Chicago and Birmingham differentials, also affected prices. The radical change in the method of pricing and selling steel, a system of some 15 years standing, was the most noteworthy feature of the industry in 1938. Pig-iron prices reflected the light demand, and while quotations held during the first 5 months of the year, prices were cut $4 a ton in the third quarter but advanced $1 a ton for fourth-quarter delivery. The Iron Age composite pig-iron price was $20.61 a ton at the end of the year compared with $23.25 at the beginning of the year. Spiegeleisen and ferromanganese prices also declined. The change in quotations came at midyear, when ferromanganese dropped $10 a ton to $92.50 at seaboard, duty paid, and spiegeleisen $5 a ton to $28. Prices of scrap fluctuated, but not as widely as in 1937. The downward trend was reversed at midyear, and by the end of the year prices were at a higher level than at the beginning. The quotation on Lake ores for the 1938 season maintained the increase established in 1937, the first since 1929.

Employee relationships, which have been receiving increased attention in recent years, were not as important a factor in 1938 as in 1937. Decline in employment in the iron and steel industries was marked, owing to the low rate of activity; nevertheless, wage rates were unchanged. The contract entered into in March 1937 between the steel-manufacturing subsidiaries of the United States Steel Corporation and representatives of the Steel Workers Organizing Committee, one of the affiliates of the Congress of Industrial Organizations, as the collective bargaining agency for employees who were members of the Amalgamated Association of Iron, Steel, and Tinworkers of America, expired in February 1938. The agreement was renewed subject to change upon 10 days' notice from either party and to termination if changes are not agreed to within 20 days of the notice. This affords an opportunity of adjustment of operations to varying economic conditions. There were no major strikes in the iron and steel industries in 1938, although the Bureau of Labor Statistics, United States Department of Labor, lists 85 strikes beginning in 1938 involving 29,372 workers and resulting in 397,022 man-days idle during

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the year. The wages-and-hours law, which provides a minimum of 25 cents per hour rate and a 44-hour week for the first year, became effective October 24, 1938, but the provisions of this act had little or no effect on the iron and steel industry.

Because steel making and finishing capacity is now physically able to take care of reasonable demands there was little addition to equipment in 1938. In many instances, the smaller returns from low operating rates necessitated lessened expenditure to conserve the cash position of the producer. However, some additional capacity was installed, resulting principally from the enlargement of present facilities, including a number of blast furnaces that were remodeled or relined. Two new blast furnaces, each of 1,000 tons daily capacity, were completed in 1938, one at Ecorse, Mich., and the other at Indiana Harbor, Ind. Eleven open-hearth furnaces (five at Indiana

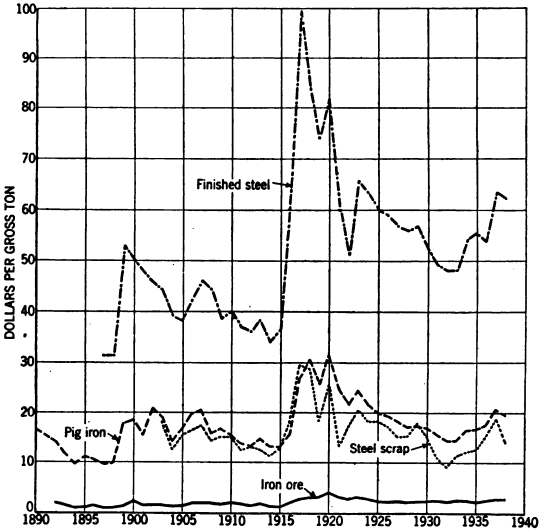


FIGURE 2.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap, 1890–1938. The prices of iron ore and pig iron are the averages f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No. 1 Heavy Melting, computed by Iron Age.

Harbor, Ind., four at Ecorse, Mich., and two at Gadsden, Ala.), with a total annual capacity of 931,300 tons, were completed in 1938. Capacity added to the finishing end of steel processes included completion of the Irvin works in the Pittsburgh district (Clairton) by the United States Steel Corporation.

Imports of iron ore into the United States decreased in 1938 from 1937 and comprised 7 percent of the domestic production, while imports of pig iron fell 73 percent and were only 0.2 percent of the domestic output. Imports of ferro-alloys also declined, but not so markedly, owing to the larger receipts of spiegeleisen and the comparatively smaller recession in ferromanganese. Imports of iron and steel manufactures, although relatively small, dropped abruptly in 1938 and were the lowest since 1921. Exports of iron and steel products were lower than in 1937 but still were at a good level; those

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of pig iron likewise dropped but maintained much of the large increase of 1937, while those for iron ore, largely to Canada, declined 53 percent. Ferro-alloy exports also were lower but do not represent much tonnage. Exports of scrap, which have attracted considerable attention in recent years, receded from the all-time peak established in 1937 but were still at a high level.

Import duties on a number of iron and steel products were lowered in 1938 under the Trade Agreements Act of June 12, 1934. These changes were provided for in the new trade agreement with Canada signed November 17, 1938, and effective January 1, 1939, which superseded the agreement signed November 15, 1935. There were also some changes, including a reduction in the duty on low-phosphorus (0.04 percent or under) pig iron from $1.125 to $0.75 per long ton, in the trade agreement with the United Kingdom, which likewise was signed on November 17, 1938, to become effective January 1, 1939.

## CONSUMPTION OF FERROUS SCRAP AND PIG IRON

Data on the consumption of ferrous scrap, formerly included in this chapter, will be found elsewhere in this volume in the chapter on Scrap Iron and Steel. Data on consumption of pig iron will be found in the pig iron section of this report.

## IRON ORE

*Production and shipments.*—Domestic output of iron ore in 1938 decreased 61 percent from 1937 and was the lowest since 1934. The 1938 tonnage was 56 percent below the 1925–29 average. Of the 172 mines (this figure does not include an undetermined number of very small open-pit operations) 4 produced more than a million tons each compared with 205 mines that included 12 in the million-ton class in 1937. Sixteen States were active producers in 1938 compared with 18 in 1937. Shipments of iron ore, which decreased 63 percent, were the lowest since 1934 and 60 percent below the 1925–29 average. The bulk of the iron ore mined in the United States is used in the manufacture of iron and steel; but 58,747 tons of the ore produced in 1938 were used for other purposes, including the manufacture of cement (46,830 tons), paint (9,694 tons), flux at nonferrous smelters (1,846 tons), and hydrogen gas (377 tons).

The quantities of iron ore shown in the following tables include ore that was beneficiated—that is, treated in any way—as well as ore that does not require treatment. Although included in the figures on production, the iron ore sold for the manufacture of paint—9,694 long tons in 1938 valued at $44,249 ($4.56 a ton) compared with 8,375 tons in 1937 valued at $48,005 ($5.73 a ton)—is not included in the shipments from mines. The output of manganiferous ore that contained 5 to 35 percent manganese also is not included; 308,860 tons valued at $858,356 were shipped in 1938 compared with 1,340,972 tons valued at $3,857,768 in 1937. In Arkansas, one producer shipped 2 tons of loadstone, which is not included in the iron ore statistics. Moreover, the statistics do not include iron sinter recovered from the roasting of domestic pyrites concentrates in Tennessee.

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*Iron ore mined in the United States in 1938, by States and varieties, in gross tons*

[Exclusive of ore containing 5 percent or more manganese]

| State | Number of active mines | Hematite | Brown ore | Magnetite | Carbonate | Total |
|---|---|---|---|---|---|---|
| Alabama | 37 | 3,970,914 | 332,415 | | | 4,303,329 |
| California | 3 | [1] 28,380 | | ([1]) | | 28,380 |
| Georgia | 4 | | 9,221 | | | 9,221 |
| Michigan | 39 | 6,004,311 | | | | 6,004,311 |
| Minnesota | 55 | 14,449,304 | | | | 14,449,304 |
| Missouri | [2] 13 | 20,213 | 8,331 | | | 28,544 |
| New Jersey | 3 | | | 185,639 | | 185,639 |
| New Mexico | 1 | | | 1,826 | | 1,826 |
| New York | 4 | ([3]) | | [3] 2,120,823 | 448 | 2,121,271 |
| Pennsylvania | 2 | | | | | |
| Utah | 2 | | | 167,933 | | 167,933 |
| Tennessee | 2 | | 13,179 | | | 13,179 |
| Virginia | 2 | | | | | |
| Washington | 2 | 3,555 | | | | 3,555 |
| Wisconsin | 2 | 854,795 | | | | 854,795 |
| Wyoming | 1 | 275,995 | | | | 275,995 |
| Total: 1938 | [2] 172 | [1 2] 25,607,467 | 363,146 | [1 3] 2,476,221 | 448 | 28,447,282 |
| 1937 | [2] 205 | [2] 68,072,781 | [4] 666,374 | [3 4] 3,353,861 | 532 | 72,093,548 |

[1] Small quantity of magnetite included with hematite.
[2] Excludes an undetermined number of small pits. The output of these pits is included in the tonnage given.
[3] Small quantity of hematite included with magnetite.
[4] Small quantity of brown ore included with magnetite.

*Quantity and tenor of iron ore mined in the United States, 1937–38, by States and mining methods*

| State | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Open pit (gross tons) | Underground (gross tons) | Total | | Open pit (gross tons) | Underground (gross tons) | Total | |
| | | | Gross tons | Iron content (nat.), percent | | | Gross tons | Iron content (nat.), percent |
| Alabama | 615,308 | 5,692,273 | 6,307,581 | 36.75 | 332,717 | 3,970,612 | 4,303,329 | 36.36 |
| California | 247 | | 247 | 51.42 | 28,380 | | 28,380 | 55.07 |
| Georgia | 14,498 | | 14,498 | 38.05 | 8,944 | 277 | 9,221 | 39.33 |
| Michigan | 2,046,981 | 10,038,067 | 12,085,048 | 51.50 | 686,981 | 5,317,330 | 6,004,311 | 52.23 |
| Minnesota | 42,734,552 | 5,682,433 | 48,416,985 | 51.83 | 11,020,523 | 3,428,781 | 14,449,304 | 52.31 |
| Mississippi | 97 | | 97 | 46.68 | | | | |
| Missouri | 18,405 | 1,550 | 19,955 | 54.25 | 27,409 | 1,135 | 28,544 | 51.33 |
| Nevada | 196 | | 196 | 65.00 | | | | |
| New Jersey | | 520,133 | 520,133 | 62.11 | | 185,639 | 185,639 | 63.24 |
| New Mexico | 10,426 | | 10,426 | 56.22 | 1,826 | | 1,826 | 61.11 |
| New York | [1] 2,625,044 | ([1]) | 2,625,044 | 67.20 | [1] 2,121,271 | ([1]) | 2,121,271 | 67.10 |
| Pennsylvania | | | | 40.79 | | | | 42.76 |
| Utah | 190,908 | | 190,908 | 54.50 | 167,933 | | 167,933 | 54.11 |
| Tennessee | 28,359 | | 28,359 | 43.38 | 13,179 | | 13,179 | 47.15 |
| Virginia | 518 | | 518 | 45.00 | | | | 52.53 |
| Washington | 8,817 | 1,227 | 10,044 | 42.30 | 1,825 | 1,730 | 3,555 | 39.41 |
| Wisconsin | | 1,155,602 | 1,155,602 | 53.47 | | 854,795 | 854,795 | 53.26 |
| Wyoming | 337,837 | 370,070 | 707,907 | 52.80 | 119,767 | 156,228 | 275,995 | 52.80 |
| | [1] 48,632,193 | [1] 23,461,355 | 72,093,548 | 50.50 | [1] 14,530,755 | [1] 13,916,527 | 28,447,282 | 49.55 |

[1] Some underground included with open pit.

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*Iron ore mined in the United States, by mining districts and varieties in 1938, in gross tons*

[Exclusive of ore containing 5 percent or more manganese]

| District | Hematite | Brown ore | Magnetite | Carbonate | Total |
|---|---|---|---|---|---|
| Lake Superior | 21,308,410 | | | | 21,308,410 |
| Birmingham | 3,970,604 | 185,476 | | | 4,156,080 |
| Chattanooga | 310 | 52,861 | | | 53,171 |
| Adirondack and Cornwall | | | [1] 2,120,823 | | [1] 2,120,823 |
| Northern New Jersey | | | 185,639 | | 185,639 |
| Other districts | [1] [2] 328,143 | 124,809 | [2] 169,759 | 448 | [1] 623,159 |
| | [1] [2] 25,607,467 | 363,146 | [1] [2] 2,476,221 | 448 | 28,447,282 |

[1] Small quantity of hematite from "Other districts" included with magnetite from Adirondack and Cornwall districts.
[2] Small quantity of magnetite included with hematite.

*Iron ore shipped from mines in the United States, 1937–38, by States*

[Exclusive of ore containing 5 percent or more manganese and ore sold for paint]

| State | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value |
| Alabama | 6,350,316 | $10,747,967 | 4,281,332 | $7,341,620 |
| California | 97 | 808 | 28,378 | (1) |
| Georgia | 14,593 | 19,130 | 9,221 | 11,375 |
| Michigan | 12,626,935 | 41,136,202 | 4,092,902 | 13,139,823 |
| Minnesota | 47,878,042 | 141,542,594 | 14,535,744 | 44,361,534 |
| Mississippi | 97 | (1) | | |
| Missouri | 19,897 | 57,687 | 20,671 | 31,514 |
| Nevada | 196 | (1) | | |
| New Jersey | 544,635 | 2,474,087 | 139,890 | 760,929 |
| New Mexico | 10,497 | (1) | 1,826 | (1) |
| New York, Pennsylvania | 2,547,082 | 5,823,286 | 2,232,837 | 5,867,320 |
| Utah | 188,794 | (1) | 169,947 | (1) |
| Tennessee | 28,359 | 89,761 | 13,456 | (1) |
| Virginia | 518 | (1) | | |
| Washington | 10,010 | 32,859 | 3,333 | (1) |
| Wisconsin | 1,419,810 | 4,473,942 | 625,378 | 1,886,477 |
| Wyoming | 707,907 | (1) | 275,995 | (1) |
| Undistributed | | [2] 1,429,890 | | [2] 921,813 |
| | 72,347,785 | 207,828,213 | 26,430,910 | 74,322,405 |

[1] Included under "Undistributed."
[2] This figure includes value for States entered as "(1)" above.

*Principal mines.*—The importance of large mining units in the iron-mining industry is shown by the fact that 13 mines, yielding more than 500,000 tons each, produced about half of the entire output in 1938. This situation, however, was not as pronounced in 1938 as in a year of heavy demand. In 1937, for example, a year of near-record output, 75 percent came from mines yielding 500,000 tons or more. In 1938, four operations—two in Minnesota, one in Alabama, and one in Pennsylvania—produced more than a million tons each compared with 12 in 1937. Of the 13 principal producing mines in 1938, 8 were open pits, 3 were operated by underground methods, and 2 were combination. Except for one mine that produced magnetite all other principal mines produced hematite.

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*Iron-ore mines of the United States that produced more than 500,000 gross tons each in 1938*

| Name of mine | State | Nearest town | District | Mining method | Gross tons |
|---|---|---|---|---|---|
| Red Mountain group | Alabama | Bessemer | Birmingham | Underground | 2,282,382 |
| Hull-Rust-Burt-Sellers group. | Minnesota | Hibbing | Mesabi | Open pit | 2,171,810 |
| Mahoning | do | do | do | do | 1,515,572 |
| Minnewas | do | Virginia | do | do | 995,590 |
| Missabe Mountain | do | do | do | do | 898,118 |
| Woodward No. 3 | Alabama | Bessemer | Birmingham | Underground | 869,502 |
| Adams-Spruce group | Minnesota | Eveleth | Mesabi | Combination | 836,480 |
| Montreal | Wisconsin | Montreal | Gogebic | Underground | 796,780 |
| Canisteo | Minnesota | Coleraine | Mesabi | Open pit | 777,881 |
| Mesabi Chief | do | Nashwauk | do | do | 597,333 |
| Hill Annex | do | Calumet | do | do | 585,783 |
| Frazer | do | Chisholm | do | do | 570,951 |
| Chateaugay [1] | New York | Lyon Mountain | Adirondack | Underground | [2] 2,120,823 |
| Cornwall | Pennsylvania | Miners Village | Cornwall | Combination | |
| Witherbee Sherman group.[1] | New York | Mineville | Adirondack | Underground | |
| Total (15 mines) | | | | | [2] 15,019,005 |
| Output of 5 mines producing between 400,000 and 500,000 tons each | | | | | 2,163,962 |
| Output of 6 mines producing between 300,000 and 400,000 tons each | | | | | 2,008,435 |
| Output of 14 mines producing between 200,000 and 300,000 tons each | | | | | 3,359,184 |
| Output of 22 mines producing between 100,000 and 200,000 tons each | | | | | 3,234,601 |
| Output of 26 mines producing between 50,000 and 100,000 tons each | | | | | 1,838,952 |
| Output of 84 [3] mines producing less than 50,000 tons each | | | | | [2] 823,143 |
| Grand total of United States (172 [3] mines) | | | | | 28,447,282 |

[1] Produced less than 500,000 tons.
[2] Output of 2 mines producing less than 50,000 tons each included with output of mines producing more than 500,000 tons each.
[3] Excludes an undetermined number of small pits. The output of these pits is included in the tonnage given.

*Beneficiation.*—Beneficiation of iron ore was reported at 43 mines in seven States in 1938 compared with 64 mines in six States in 1937. At many mines the ore is crushed and screened to improve its structure, but ore so improved is not included in the statistics of beneficiated ore. Some iron ore is recovered in the form of dust from blast furnaces; data on ore so recovered, however, have been accounted for previously in shipments from mines.

Beneficiated ore shipped from domestic mines in 1938 decreased 61 percent from 1937 and comprised 18 percent of the total shipments in 1938 compared with 17 percent in 1937.

*Beneficiated iron ore shipped from mines in the United States, 1937–38*

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

| State | Variety | 1937 | | 1938 | |
|---|---|---|---|---|---|
| | | Gross tons | Value | Gross tons | Value |
| Alabama | Brown ore | 532,570 | $1,297,070 | 263,766 | $605,226 |
| Minnesota | Hematite and magnetite | 9,396,874 | 26,462,257 | 2,805,996 | 8,150,937 |
| New Jersey | Magnetite | 542,758 | 2,472,517 | 139,890 | 760,929 |
| New York | do | 1,854,249 | 5,780,303 | 1,613,602 | 4,443,421 |
| Pennsylvania | do | | | | |
| Tennessee | Brown ore | 23,685 | 78,101 | 13,181 | 34,542 |
| California | Magnetite | | | | |
| | | 12,350,136 | 36,090,248 | 4,836,435 | 13,995,055 |

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The quantity of crude ore beneficiated in the Lake Superior district (all in Minnesota) in 1938 totaled 5,112,485 gross tons and the beneficiated ore recovered 2,999,464 tons—a ratio of 1.704 to 1. In 1937 the crude ore treated totaled 15,746,547 tons and the beneficiated ore recovered therefrom 9,512,667 tons—a ratio of 1.655 to 1. Most of the concentration in this district is done by washing, but a few plants are equipped with jigs. Processes have been described by Zapffe and Hunner.[2] Most of the concentrated ore shipped from Minnesota is obtained in the treatment of wash ores which yield 65 percent concentrates and 35 percent tailings containing about 22 percent iron. Preliminary tests of a limited number of samples indicate that wash ore tailings are amenable to concentration by flotation and that a merchantable commodity can be produced.[3] The commercial possibilities have been discussed by Counselman.[4] In recent years there has been developed on the Mesabi range a process for roasting ore to the magnetic state and concentrating it on magnetic separators. The process, which is applicable to ores that cannot be concentrated either by washing or jigging, has been described by Davis.[5] A plant utilizing the process produced 6,361 tons of concentrates in 1938, which averaged (natural) 54.80 percent iron, 0.22 percent manganese, 0.046 percent phosphorus, 12.25 percent silica, and 10.04 percent moisture from 12,054 tons of jig tailings—a ratio of 1.895 to 1. The operation of the plant has been described by Craig.[6]

Beneficiated ore comprised a slightly larger part of the total shipments in 1938. Relieved of the pressure of production maintained in 1937, operators apparently did not find it necessary to supply a relatively larger proportion of the total from direct shipping ores. Data for recent years are shown in the following table, and corresponding statistics for 1914 (the first year for which they were gathered) to 1929 are given in Mineral Resources, 1930. Data for 1930 to 1933, inclusive, are given in Minerals Yearbook, 1935.

*Iron ore shipped from mines in the United States, 1925–29 (average) and 1934–38, in gross tons, and percentage of beneficiated ore compared to the total shipped*

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

| Year | Beneficiated | Total | Percentage of beneficiated to total | Year | Beneficiated | Total | Percentage of beneficiated to total |
|---|---|---|---|---|---|---|---|
| 1925–29 (aver.) | 8,653,590 | 66,697,126 | 13.0 | 1936 | 9,658,699 | 51,465,648 | 18.8 |
| 1934 | 4,145,590 | 25,792,606 | 16.1 | 1937 | 12,350,136 | 72,347,785 | 17.1 |
| 1935 | 6,066,601 | 33,426,486 | 18.1 | 1938 | 4,836,435 | 26,430,910 | 18.3 |

*Average value.*—The average value per gross ton of iron ore at the mines was $2.81 in 1938 compared with $2.87 in 1937.

The table that follows gives the average value at the mines of the different classes of iron ore in 1937–38 for each of the producing

[2] Zapffe, Carl, and Hunner, E. E., Preparation for Market Requirements, Shipment and Reduction: Lake Superior Iron Ores, Chap. 6, Lake Superior Iron Ore Assoc., Cleveland, 1938, pp. 77–84.
[3] Searles, John N., Some Tests with Flotation on Mesabi Wash-Ore Tailings: Eng. and Min. Jour., vol. 139, No. 6, June 1938, pp. 42–44.
[4] Counselman, T. B., Dollars in Current Tailings of Mesabi Washing Plants: Eng. and Min. Jour., vol. 140, No. 4, April 1939, pp. 34–36.
[5] Davis, E. W., First Magnetic Roasting Plant in the Lake Superior Region: Am. Inst. Min. and Met. Eng. Tech. Pub. 731, 1937, pp. 1–19.
[6] Craig, J. J., Magnetic Concentration on the Mesabi Makes Progress: Eng. and Min. Jour., vol. 139, No. 1, January 1938, pp. 48–52.

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States or groups of States, except where there are fewer than three shippers of a certain variety of ore in a State and permission was not given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately, as not all reports are comparable. Some evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking fund; and still others comprise only costs charged against blast furnaces. None of the reports, however, is supposed to include freight charges.

*Average value per gross ton of iron ore at mines in the United States, 1937–38*

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

| State | Hematite | | Brown ore | | Magnetite | |
|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 |
| Alabama | $1.62 | $1.67 | $2.39 | $2.34 | | |
| Georgia | | | 1.31 | 1.23 | | |
| Michigan | 3.26 | 3.21 | | | | |
| Minnesota | 2.96 | 3.05 | | | (1) | |
| Missouri | 5.91 | 1.51 | (1) | (1) | | |
| New Jersey | | | (1) | | $4.56 | $5.44 |
| New York | | | | | 2.29 | 2.63 |
| Pennsylvania | | | | | | |
| Tennessee | | | 3.17 | (1) | | |
| Wisconsin | 3.15 | 3.02 | | | | |
| Other States [2] | 1.26 | 1.35 | 3.93 | 2.49 | 2.76 | 2.76 |
| | 2.89 | 2.82 | 2.40 | 2.31 | 2.69 | 2.79 |

[1] Less than 3 producers; permission to publish not given, therefore value may not be shown.
[2] 1937: California, Mississippi, Nevada, New Mexico, Utah, Virginia, Washington, and Wyoming; 1938: California, New Mexico, Tennessee, Utah, Virginia, Washington, and Wyoming.

*Consumption.*—The production of 18,582,322 gross tons of pig iron in 1938 required 32,373,834 tons of iron and manganiferous iron ores, 2,271,055 tons of mill cinder and roll scale, and 300,578 tons of purchased scrap, an average of 1.880 tons of metalliferous materials per ton of iron made.

The greater part of the iron ore used in Alabama furnaces in 1938 was hematite, chiefly from mines in Jefferson County, but some came from Etowah and St. Clair Counties. Considerable brown ore, iron sinter, pyrite ash, and imported iron ore and manganese ore and small quantities of domestic manganese-bearing ores were used. The brown ore came chiefly from mines in the Birmingham and Russellville districts, Alabama. In addition to the iron sinter (sintered pyrite ash) from Tennessee, considerable pyrite ash was shipped to Birmingham in 1938 from acid plants in other Southern States. The pyrite from which the ash was made was of both domestic and foreign origin. The domestic manganese-bearing ores came chiefly from Alabama, Arkansas, Georgia, and Tennessee. Imported manganese-bearing ores came from Cuba. In 1938 Alabama furnaces consumed an average of 2.460 tons of ore in making 1 ton of pig iron, the highest average for any State.

Maryland furnaces consumed considerable domestic ore in 1938 in addition to ores from Africa, Australia, Brazil, Chile, and Cuba. These furnaces used an average of 1.554 tons of ore per ton of pig iron; however, they used proportionately more cinder, scale, and scrap than furnaces in any other State.

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Illinois, Indiana, Kentucky, Michigan, Minnesota, Ohio, and West Virginia blast furnaces operated on Lake Superior iron ore and manganiferous iron ore exclusively. Kentucky furnaces had the lowest consumption of metal-bearing material per ton of iron.

In New York the furnaces in the Buffalo district used ore chiefly from the Lake Superior district, and the furnace at Standish handled magnetite from the Chateaugay mine at Lyon Mountain, N. Y. The furnace at Troy used chiefly magnetite from Mineville, N. Y., plus some manganese-bearing material from Canada in 1938.

Virtually all the ore consumed in western Pennsylvania furnaces came from the Lake Superior district. Those in the eastern part of the State used some Lake ores; magnetite ores from Pennyslvania, New Jersey, and New York; and considerable ore from Australia, Chile, Cuba, India, Sweden, and the U. S. S. R.

The Pueblo (Colo.) blast furnaces employed hematite from the Sunrise mine in Wyoming, rhodochrosite from Butte, Mont., and manganese-bearing ores from Colorado and New Mexico.

The Provo (Utah) furnace consumed chiefly semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, and manganese tailings from Philipsburg, Mont.

The Tennessee furnace used Tennessee brown ore and iron sinter.

*Iron ore and other metallic materials consumed and pig iron produced in 1938, by States, in gross tons*

| State | Metalliferous materials consumed | | | | Pig iron produced, exclusive of ferro-alloys | Materials consumed per ton of iron made | | |
|---|---|---|---|---|---|---|---|---|
| | Iron and manganiferous iron ores | | Cinder, scale, and purchased scrap | Total | | Ores | Cinder, scale, and purchased scrap | Total |
| | Domestic | Foreign | | | | | | |
| Alabama | 4,957,932 | 19,298 | 63,465 | 5,040,695 | 2,023,269 | 2.460 | 0.031 | 2.491 |
| Illinois | 2,859,547 | ---------- | 181,714 | 3,041,261 | 1,656,591 | 1.726 | .110 | 1.836 |
| Indiana | 2,998,038 | ---------- | 345,473 | 3,343,511 | 1,791,085 | 1.674 | .193 | 1.867 |
| Kentucky | 190,178 | ---------- | 20,552 | 210,730 | 126,102 | 1.508 | .163 | 1.671 |
| Maryland | 457,672 | 1,409,541 | 245,338 | 2,112,551 | 1,201,374 | 1.554 | .204 | 1.758 |
| Michigan | 900,970 | ---------- | 92,329 | 993,299 | 556,230 | 1.620 | .166 | 1.786 |
| New York | 2,328,868 | 6,005 | 53,428 | 2,388,301 | 1,338,907 | 1.744 | .040 | 1.784 |
| Ohio | 6,890,525 | ---------- | 582,007 | 7,472,532 | 4,210,514 | 1.637 | .138 | 1.775 |
| Pennsylvania | 7,836,723 | 72,740 | 910,252 | 8,819,715 | 4,836,093 | 1.636 | .188 | 1.824 |
| West Virginia | 799,006 | ---------- | 38,537 | 837,543 | 472,738 | 1.690 | .082 | 1.772 |
| Undistributed [1] | 646,791 | ---------- | 38,538 | 685,329 | 369,419 | 1.751 | .104 | 1.855 |
| | 30,866,250 | 1,507,584 | 2,571,633 | 34,945,467 | 18,582,322 | 1.742 | .138 | 1.880 |

[1] Includes Colorado, Iowa, Minnesota, Tennessee, Utah, and Virginia.

*Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1937–38, by sources of ore, in gross tons*

| Source of ore | 1937 | 1938 | Source of ore | 1937 | 1938 |
|---|---|---|---|---|---|
| Africa | 4,184 | 8,711 | Norway | 3,983 | ---------- |
| Asia | 2,864 | 108 | Spain | 1,658 | ---------- |
| Australia | 140,372 | 61,473 | Sweden | 1,245 | 4,215 |
| Brazil | ---------- | 9,597 | U. S. S. R. | 36,737 | 77 |
| Chile | 1,385,708 | 1,232,156 | Undistributed | 15,456 | 16,203 |
| Cuba | 452,553 | 175,044 | | | |
| Newfoundland | 32,045 | ---------- | | 2,076,805 | 1,507,584 |

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*Stocks at mines.*—During 1938 stocks at the mines increased appreciably and at the end of the year were considerably above the low level of the two preceeding years. The increase during 1938 was 38 percent.

*Stocks of iron ore at mines, Dec. 31, 1937–38, by States, in gross tons*

| State | 1937 | 1938 | State | 1937 | 1938 |
|---|---|---|---|---|---|
| Alabama | 5,509 | 27,506 | Pennsylvania | 71,914 | 79,125 |
| Michigan | 3,371,190 | 5,299,847 | Utah | 2,014 | |
| Minnesota | 1,763,972 | 1,728,263 | Virginia | 3,363 | 3,086 |
| Missouri | 3,150 | 4,523 | Washington | 33 | 255 |
| New Jersey | 49,344 | 95,093 | Wisconsin | 126,064 | 356,579 |
| New York | 129,811 | 16,571 | | | |
| North Carolina | 200 | 200 | | 5,526,564 | 7,611,048 |

*Foreign trade.*—Imports of iron ore in 1938 decreased 13 percent from 1937. Chile continued to be the chief source of imports into this country, furnishing 74 percent of the 1938 total, while Sweden supplied 10 percent and Cuba 7. In addition to the figures in the following table, 61 tons of dross or pyrites ash were imported from Canada.

*Iron ore imported for consumption in the United States, 1936–38, by countries, in gross tons*

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value | Gross tons | Value |
| Algeria | 12,293 | $38,602 | 3,700 | $17,424 | 7,480 | $32,170 |
| Australia | 72,904 | 158,327 | 79,588 | 137,444 | 82,827 | 138,614 |
| Brazil | 6,102 | 22,209 | 11,000 | 26,620 | 9,650 | 44,170 |
| Canada | 83,911 | 407,230 | 5,046 | 44,156 | 875 | 26,441 |
| Chile | 1,264,130 | 2,291,010 | 1,438,886 | 2,608,696 | 1,577,750 | 2,853,060 |
| Cuba | 444,500 | 1,055,908 | 441,500 | 1,065,929 | 148,701 | 357,730 |
| Germany | 11 | 477 | | | | |
| India, British | | | 845 | 10,567 | | |
| Iran (Persia) | 2 | 84 | 3,385 | 55,713 | 5,648 | 90,969 |
| Mexico | 3,687 | 8,933 | 4,183 | 9,613 | | |
| Newfoundland and Labrador | 11,300 | 34,352 | 45,080 | 115,804 | | |
| Norway | 158,344 | 557,917 | 252,657 | 919,936 | 75,625 | 394,705 |
| Philippine Islands | 377 | 2,936 | 350 | 4,200 | | |
| Spain | 198 | 2,655 | | | | |
| Sweden | 166,150 | 678,451 | 150,233 | 796,953 | 213,616 | 1,339,393 |
| U. S. S. R. | 7,750 | 11,238 | 5,100 | 8,466 | | |
| United Kingdom | 570 | 9,868 | 516 | 20,116 | 228 | 10,131 |
| Yugoslavia | | | | | 55 | 812 |
| | 2,232,229 | 5,280,197 | 2,442,069 | 5,841,637 | 2,122,455 | 5,288,195 |

Exports of iron ore from the United States totaled 591,524 gross tons valued at $1,954,287 ($3.30 a ton) in 1938 compared with 1,264,102 tons valued at $4,039,248 ($3.20 a ton) in 1937. Of the 1938 total, 591,185 tons went to Canada.

*Mining in Cuba.*—Shipments of iron ore from Cuba to the United States decreased 69 percent in 1938 from 1937. The 1938 total of 152,099 gross tons included 95,721 tons of hematite carrying (dried) 54.86 percent iron and 45,491 tons of siliceous ore carrying (dried) 31.65 percent iron from the Daiquiri-Juragua mines on the southern coast and 10,887 tons of nodulized brown ore carrying (dried) 55.41 percent iron from the Mayari mines near the northern coast. The Mayari mine was idle during the last 9 months of the year.

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The total stock of ore reported on hand was 170,044 gross tons at the end of the year compared with 86,787 at the end of 1937.

The following table shows shipments of iron ore from Cuba since the mines were opened in 1884. The statistics on shipments of Cuban iron ore are collected by the Bureau of Mines.

*Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1938, in gross tons*

| Year | Juragua (hematite and magnetite), Daiquiri (hematite and a little magnetite) | Sigua (hematite) | Mayari (brown ore) | Guamá (hematite) | El Cuero (hematite) | Total |
|---|---|---|---|---|---|---|
| 1884–1936 | [1] 21,331,616 | 20,438 | 3,812,040 | 41,241 | 903,103 | 26,108,438 |
| 1937 | 452,882 | ---------- | 35,537 | ---------- | ---------- | 488,419 |
| 1938 | 141,212 | ---------- | 10,887 | ---------- | ---------- | 152,099 |
| | 21,925,710 | 20,438 | 3,858,464 | 41,241 | 903,103 | 26,748,956 |

[1] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia, and 64,228 tons to other ports outside of the United States.

## REVIEW OF LAKE SUPERIOR DISTRICT

*Production.*—Activities in the Lake Superior district (the principal producing district) were at a much lower rate in 1938. The abrupt decline in steel production during the last quarter of 1937, and the low operating rate that was maintained subsequently, reduced consumption; in consequence, abnormally high stocks accumulated at lower Lake ports and furnaces at the beginning of the 1938 shipping season. The larger stocks, together with the lower level of steel operations which continued throughout 1938, reduced the demand for Lake ores. Production decreased 65 percent and was the lowest since 1934. The district furnished 75 percent of the United States total in 1938 compared with 86 percent in 1937. The lower proportionate share is a result of higher rates of steel activity in districts depending on other ores, notably the Birmingham district.

Several ranges contribute to the district total. The Mesabi was the largest producer, contributing 62 percent of the district total and 47 percent of the United States total in 1938. The output, by ranges, is shown in the following table. After 1905, the figures do not include manganiferous iron ore containing 5 percent or more manganese.

*Iron ore mined in the Lake Superior district, 1854–1938, by ranges, in gross tons*

[Exclusive after 1905 of ore containing 5 percent or more manganese]

| Year | Marquette | Menominee | Gogebic | Vermilion | Mesabi | Cuyuna | Total |
|---|---|---|---|---|---|---|---|
| 1854–1936 | 189,309,480 | 179,272,258 | 201,274,214 | 63,288,269 | 984,192,997 | 24,538,932 | 1,641,876,150 |
| 1937 | 5,631,434 | 2,293,039 | 5,315,677 | 1,514,292 | 46,270,866 | 631,827 | 61,657,135 |
| 1938 | 2,686,713 | 1,283,563 | 2,888,830 | 932,505 | 13,256,605 | 260,194 | 21,308,410 |
| | 197,627,627 | 182,848,860 | 209,478,721 | 65,735,066 | 1,043,720,468 | 25,430,953 | 1,724,841,695 |

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Much of the ore produced on the iron ranges of the Lake Superior district comes from open-pit mines. In 1938 this amounted to 55 percent. A large part of the open-pit production comes from operations on the Mesabi range, which in 1938 supplied 93 percent of the open-pit ore mined in the district. There is no open-pit mining in Wisconsin and relatively little in Michigan. In addition to the output on the Mesabi range there is some open-pit production in Minnesota on the Cuyuna range.

Recent years have witnessed significant changes in open-pit mining practice in the iron country. In the past the trend toward larger units, the replacement of steam by electric power on excavating shovels with caterpillar treads, and (to a more limited extent) the use of electric transportation equipment were the usual development. During the last few years, however, the increased use of trucks and the introduction of large belt conveyors to replace locomotive haulage out of pits are noteworthy. Small, standard-type dump trucks have been used in clean-up or scram operations within the pits, but during the 1936 season the first effort was made to use heavy truck haulage in transporting overburden and iron ore. The new units in use today range from 15 to 20 tons in capacity and are equipped with powerful gasoline or Diesel engines and supplemented by trailers or wagons on rubber or crawler treads.[7] Trucks handling 35 tons of ore have been tested at some properties. The moving of ore from pits, including the use of trucks and trailers, has been discussed by Moore,[8] while the application of trucks has been described by Whitney and Holt.[9] Conveyor belts originally were used in this district in concentrators and first applied to iron mining at the La Rue mine,[10] an underground operation. The use of tractors and wagons with caterpillar treads, and of conveyors for transporting ore from shovels to the surface is a feature of operations at the St. Paul pit near Keewatin. Crawling tractor trucks equipped with trailers are used to bring the ore to the conveyor-belt system, which is 900 feet long. Trucks and conveyor belts also are used at the Leetonia mine, whereas the Louise pit on the Cuyuna range uses Diesel-powered trucks only. In August 1937 a conveyor-belt system 4,481 feet long with a lift of 387 feet was put into operation at the Spruce open-pit mine, Eveleth, Minn., where the depth had reached the economical limit for steam-locomotive haulage. The Spruce open pit operated entirely under this new mining method throughout the 1938 shipping season. The new conveyor system, which will convey 750 tons per hour to a shipping pocket on the surface, extends under the ore body, and the ore is fed to the belt through raises equipped with jaw crushers and feeders. The ore is transported to the raises by tower excavators or by 20-ton trucks. The mining method has been described by Schwedes.[11] At the Judd pit on the western Mesabi range a truck-conveyor transport system with an 800-foot conveyor belt was erected in 1937. It

[7] Anderson, A. E., Riddell, J. M., and Holt, Grover, J., Recent Improvements in Mining Practice on the Mesabi Range: Am. Inst. Min. and Met. Eng. Tech. Pub. 968, November 1938, pp. 1–16.

[8] Moore, L. C., Open-Pit Transport on the Mesabi Range: Eng. and Min. Jour., vol. 139, Nos. 10, 11, 12, vol. 140, Nos. 1, 3, October, November, and December 1938; January, March 1939, pp. 44–47, 52–54, 50–52, 49–53, 46–48.

[9] Whitney, R. W., and Holt, G. J., Truck Haulage on the Mesabi and Cuyuna Ranges: Eng. and Min. Jour., vol. 140, No. 1, January 1939, pp. 29–33.

[10] Holt, G. J., Conveyor Transport in an Underground Mine on the Mesabi: Eng. and Min. Jour., vol. 139, No. 1, January 1938, pp. 29–31, 52.

[11] Schwedes, W. F., A New Method of Mining Mesabi Range Open Pit Iron Ore: Min. Cong. Jour., vol. 24, No. 12, December 1938, pp. 18–23.

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is reported that similar operations are planned at other mines, as the combination of trucks, smaller shovels, and scrapers permits greater flexibility, and such equipment may be used alone as well as with the heavier railroad-type transportation equipment now predominating. Such operations permit removal of ore tied up in track benches and allow extraction closer to property lines. Smaller ore bodies and clean-up jobs around larger pits may also be handled. In addition, conveyor installations may be adapted to underground practice using top-slicing or sublevel-caving methods.

New methods in iron-mining technology are not confined to open-pit operations. A new circular ventilating shaft 5½ feet in diameter and 1,208 feet deep, using the shot-drill method developed at the Idaho-Maryland mine in California, was sunk during 1938 at the Zenith mine on the Vermilion range. This method of sinking mine openings is reported to be safer, cheaper, and faster than earlier methods.[12] The sublevel-caving method of mining used in the larger ore bodies at the Montreal mine in Wisconsin has been described by Bowen.[13]

A new handbook relating to the Lake Superior iron-mining industry has been published by the Lake Superior Iron Ore Association.[14] It contains chapters on history, geology, mineralogy, classification and sampling, grading, preparations for market requirements, shipment, and reduction; a directory of the mines; maps of all ranges; a flow map; and tables and charts showing shipments, distribution and consumption of ore, analyses, reserves, taxes, prices, and other pertinent information.

*Shipments.*—Interlake navigation in 1938 opened on April 13, but only 260,513 gross tons were shipped from Lake ports during the month compared with 3,770,555 tons in April 1937. The season's total was considerably below that in 1937 and with the exception of 1932 was the lowest since 1900. Shipments of ore from the Lake Superior district totaled 19,546,835 gross tons (19,254,171 tons of iron ore and 292,664 tons of manganese-bearing ores containing 5 percent or more manganese) in 1938 compared with 63,194,044 tons (61,926,405 tons of iron ore and 1,267,639 tons of manganese-bearing ores) in 1937. The iron ore statistics given above include 147 tons of paint ore in 1938 and 1,618 tons in 1937.

*Analyses.*—The following table, compiled by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore shipped and shows the remarkable uniformity maintained during the past 5 years. This uniformity does not mean, of course, that the average grade of available Lake Superior ore is not declining. The grade of shipments has been maintained partly by beneficiation and partly by mixing ores from different deposits. The method of sampling and grading Lake Superior iron ores has been described by Bayer,[15] and the method of classification and sampling has been described by Murray.[16]

[12] Newson, J. W., and Haselton, W. D., Borehole at the Zenith Mine, Ely, Minn.: Am. Inst. Min. and Met. Eng. Tech. Pub. 1068, February 1939, pp. 1–14.

[13] Bowen, R. A., Sublevel Caving, Large-Pillar Method, at the Montreal Mine: Am. Inst. Min. and Met. Eng. Tech. Pub. 886, February 1938, pp. 1–9.

[14] Lake Superior Iron Ore Association, Lake Superior Iron Ores: Cleveland, 1938, 412 pp.

[15] Bayer, E. P., Sampling and Grading Mesabi Iron Ore: Min. and Met., vol. 18, No. 372, December 1937, pp. 547–548.
Bayer, E. P., Grading Lake Superior Iron Ores: Eng. and Min. Jour., vol. 139, No. 3, March 1938, pp. 50–51.

[16] Murray, C. B., Classification and Sampling: Lake Superior Iron Ores, Chap. 4, Lake Superior Iron Ore Association, Cleveland, 1938, pp. 69–72.

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*Average analyses of total tonnages of all grades of iron ore from all ranges of Lake Superior district, 1934–38*

| Year | Gross tons | Iron (natural) | Phosphorus | Silica | Manganese | Moisture |
|---|---|---|---|---|---|---|
| | | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 1934 | 21,841,382 | 51.49 | 0.087 | 8.93 | 0.76 | 10.66 |
| 1935 | 28,214,056 | 51.44 | .093 | 8.93 | .79 | 10.75 |
| 1936 | 44,745,754 | 51.45 | .091 | 8.62 | .81 | 10.92 |
| 1937 | 61,972,823 | 51.53 | .091 | 8.27 | .82 | 11.31 |
| 1938 | 19,353,497 | 51.90 | .089 | 8.25 | .81 | 10.13 |

*Stocks at Lake Erie ports.*—At the close of navigation in 1938, according to the Lake Superior Iron Ore Association, 5,290,294 gross tons were in stock at Lake Erie ports compared with 6,073,262 tons on the corresponding date in 1937. At the opening of navigation in May 1939, 4,484,967 tons were in stock at these ports, a decrease of 910,542 tons from the figure on May 1, 1938. Withdrawals from docks were therefore only 805,327 tons during the winter of 1938–39.

*Prices of Lake Superior ore.*—The prices established May 23, 1938, for the four standard grades of Lake Superior ore were the same as for 1937 but 45 cents per ton more than the price that had been maintained for 1929 to 1936. The unit prices for 1937 and 1938 for base ore of the various grades quoted at Lake Erie ports were as follows: Old-range Bessemer, 10.194 cents; Mesabi Bessemer, 9.903 cents; Old-range Nonbessemer, 9.903 cents; and Mesabi Nonbessemer, 9.612 cents. The prices per gross ton that correspond to these unit prices are, respectively, $5.25, $5.10, $5.10, and $4.95. The base of the four standard grades for 1925–38 is an iron content of 51.5 percent natural. For the bessemer grades the phosphorus content is 0.045 percent (dry), while for the nonbessemer grades the phosphorus content ranges from 0.045 to 0.18 percent. Ores containing over 0.18 percent phosphorus are classed as high-phosphorus ores, while those containing 18 percent or more silica are classed as siliceous ores.

*Reserves.*—Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of Tax Commissioners, shown in the following tables cover developed and prospective ore in the ground and ore in stock piles. These estimates reveal a decrease from the previous year of 23,201,051 gross tons in Minnesota but an increase of 1,147,551 tons in Michigan. Reserves in Wisconsin have been estimated recently at 5,500,000 tons.

*Iron-ore reserves in Minnesota, May 1, 1934–38, in gross tons*

| Range | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Mesabi | 1,195,271,786 | 1,177,302,197 | 1,180,391,647 | 1,173,108,376 | 1,150,808,768 |
| Vermilion | 13,243,125 | 13,656,569 | 13,489,847 | 13,943,325 | 14,274,025 |
| Cuyuna | 47,553,536 | 46,874,462 | 63,226,789 | 61,922,739 | 60,690,596 |
| | 1,256,068,447 | 1,237,833,228 | 1,257,108,283 | 1,248,974,440 | 1,225,773,389 |

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*Iron-ore reserves in Michigan, Jan. 1, 1935–39, in gross tons*

| Range | 1935 | 1936 | 1937 | 1938 | 1939 |
|---|---|---|---|---|---|
| Gogebic | 47,721,016 | 45,615,323 | 42,757,025 | 40,706,291 | 40,456,002 |
| Marquette | 53,513,561 | 52,461,173 | 51,339,347 | 49,869,363 | 52,130,385 |
| Menominee | 60,978,904 | 60,347,752 | 59,936,572 | 58,031,692 | 57,168,510 |
| | 162,213,481 | 158,424,248 | 154,032,944 | 148,607,346 | 149,754,897 |

## MINING BY STATES

*Alabama.*—Although output of iron ore in Alabama was curtailed in 1938 the reduction was not as severe as in other large producing districts, and a number of mines that had been shut down resumed operations later in the year. Production in Alabama in 1938 decreased 32 percent from 1937. About 92 percent of the 1938 production came from underground mines and the remainder from open-cuts. Hematite represented 92 percent of the 1938 total, and much of this red ore contained enough or nearly enough lime to be self-fluxing. The hematite is derived chiefly from underground mines on Red Mountain near Birmingham in Jefferson County, where in 1938 Raimund Nos. 1 and 2, Red Mountain group (comprising the Muscoda, Wenonah, and Ishkooda groups), Sloss Nos. 1 and 2, Spaulding, and Woodward No. 3 mines contributed to production. The iron content of the hematite produced in 1938 averaged (natural) 35.49 percent, the manganese content 0.16 percent, the phosphorus content 0.31 percent, and the lime content 15.42 percent. The Red Mountain group with 2,282,382 tons was the largest producer in the United States in 1938.

Limonite (brown ore) is mined from a number of widely scattered deposits in Alabama, but production is not nearly so large as that of red ore. In 1938 brown ore comprised 8 percent of the Alabama total. Brown ores, however, are of higher grade and usually have been subjected to beneficiation, although some operations are rather crude. The brown ore mined in 1938 averaged (natural) 47 percent iron and 0.72 percent manganese. Brown ore is mined from open-cuts and was produced chiefly from the Russellville mines in Franklin County, the Champion mine in Blount County, and the Martaban, Reno, and Woodstock mines in Tuscaloosa County.

*California.*—Production in California in 1938 was small and came from three mines, one producing magnetite (in Santa Cruz County) and two producing hematite (one in San Bernardino County and one in Inyo County). The magnetite averaged 60 percent iron; the hematite, which averaged 55 percent iron, was absorbed chiefly by the cement industries.

*Georgia.*—Four mines in Bartow and Polk Counties furnished the output from Georgia in 1938. The Cartersville Barium Corporation in Bartow County was the largest producer. The entire output from Georgia was brown ore and contained (natural) 37 to 49 percent iron and 0.17 to 4 percent manganese.

*Michigan.*—Output from Michigan comes from three ranges—the Marquette, the Menominee, and the Gogebic. All ranges decreased their production in 1938, the Marquette showing the largest tonnage

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decline. Production in Michigan decreased 50 percent in 1938 from 1937 and totaled 6,004,311 gross tons. Eighty-nine percent of the 1938 total came from underground mines; the Maas mine, an underground producer on the Marquette range, was the largest producer. The iron content (natural) of the ore mined in 1938 averaged 52.23 percent compared with 51.50 percent in 1937.

Iron-ore reserves in Michigan at the end of 1938 totaled 149,754,897 gross tons, an increase of 1,147,551 tons during the year.

A report of the iron ore mines of Michigan for 1938, published by the Geological Survey Division of the Michigan Department of Conservation,[17] shows that the average number of men employed was 5,633 (6,230 in 1937), the average number of days worked 157 (238 in 1937), the average daily wage $7.59 ($7.05 in 1937), the average yearly earning $1,192.29 ($1,678.19 in 1937), and the average tons of ore mined per man per day 5.32 (7.12 in 1937).

The data in the following table on average per-ton costs of mining ore at underground mines and at siliceous open pits have been abstracted from statistics published in much greater detail by the Geological Survey Division of Michigan.

*Average per-ton costs of mining iron ore at underground mines and at siliceous open pits in Michigan in 1938*

| Item | Underground | | | | Siliceous open pits |
|---|---|---|---|---|---|
| | Gogebic | Marquette | Dickinson and Iron | Total | |
| Cost of mining | $2.0036 | $2.0306 | $1.9554 | $2.0037 | $0.6689 |
| Deferred mining cost | .2622 | .0732 | .1275 | .1480 | .0596 |
| Taxes | .4889 | .4223 | .2745 | .4087 | .0806 |
| General overhead | .2670 | .2606 | .2409 | .2580 | .1305 |
| Transportation | 1.8194 | 1.5140 | 1.6326 | 1.6621 | 1.5176 |
| Marketing | .0572 | .1032 | .0795 | .0807 | .0780 |
| Royalty | .4163 | .3138 | .2767 | .3390 | .0879 |
| Interest on borrowed money | .0009 | .0054 | .0014 | .0079 | .0001 |
| Total ore cost | 5.3155 | 4.7231 | 4.5885 | 4.9081 | 2.6232 |
| Lake Erie value per ton | 5.3916 | 5.2386 | 5.0166 | 5.2307 | 2.4412 |
| Gross ore profit [1] | .0761 | .5155 | .4281 | .3226 | —.1820 |

[1] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

*Minnesota.*—More than 1 billion gross tons (1,134,886,487) of iron ore have been produced in Minnesota. In 1938 output decreased 70 percent from the record total in 1937. Three ranges contribute to Minnesota's production—the Cuyuna, the Mesabi, and the Vermilion. The Mesabi range supplies a large part of the Minnesota total and in 1938 produced 13,256,605 tons. Output from open-pit mines in 1938 supplied 76 percent of the Minnesota total compared with 88 percent in 1937 and 86 percent in 1936. Of the four domestic mines producing more than 1 million tons each in 1938 two were in Minnesota, and both were open pits. Of the 55 mines in Minnesota active in 1938 (84 in 1937), 29 (51 in 1937) yielded more than

[17] Pardee, F. G., and Eddy, G. E., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., Lansing, 1939.



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100,000 tons each. The iron content (natural) of the ore mined in 1938 averaged 52.31 percent compared with 51.83 percent in 1937.

According to the annual report of the mine inspector of St. Louis County, an average of 3,773 men was employed in iron mines in St. Louis County during 1938 (6,356 in 1937), and the average daily wage was $6.60 ($6.56 in 1937) for 8 hours. In 1938, 3,762,318 cubic yards of overburden were removed compared with 4,529,716 yards in 1937.

In Crow Wing County (Cuyuna range), 384 men were employed in 1938 compared with 894 men in 1937, according to the mine inspector's report. Two hundred and four thousand seven hundred and forty-two cubic yards of overburden were removed in 1938 compared with 1,670,862 yards in 1937.

According to the annual report of the mine inspector of Itasca County, an average of 2,132 men was employed in iron mines in 1938 (4,353 in 1937), and the average daily wage was $5.82 ($6.10 in 1937) for 8 hours. In 1938, 3,807,920 cubic yards of overburden were removed compared with 6,299,581 yards in 1937.

The data in the following table on costs of developing and mining iron ore have been abstracted from statistics published in greater detail by the Minnesota Tax Commission.

*Average per-ton costs of developing and mining iron ore at open-pit and underground operations in Minnesota, 1933–37*

| Year | Developing | Mining | | | Royalty | Total |
|---|---|---|---|---|---|---|
| | | Labor | Supplies | Other items | | |
| Open-pit operations: | | | | | | |
| 1933 | $0.259 | $0.098 | $0.116 | $0.226 | $0.419 | $1.118 |
| 1934 | .248 | .135 | .127 | .205 | .405 | 1.120 |
| 1935 | .253 | .137 | .122 | .172 | .457 | 1.141 |
| 1936 | .230 | .149 | .134 | .197 | .396 | 1.106 |
| 1937 | .242 | .169 | .142 | .151 | .375 | 1.079 |
| Underground or mixed operations: | | | | | | |
| 1933 | .138 | .700 | .466 | .352 | .421 | 2.077 |
| 1934 | .060 | .809 | .427 | .303 | .403 | 2.002 |
| 1935 | .065 | .764 | .428 | .249 | .389 | 1.895 |
| 1936 | .048 | .774 | .456 | .275 | .446 | 1.999 |
| 1937 | .055 | .973 | .517 | .283 | .410 | 2.238 |

Iron ore reserves in Minnesota on May 1, 1938, totaled 1,225,773,389 gross tons, a decrease of 23,201,051 tons from the previous year.

*Missouri.*—An undetermined number of small operations in Butler, Carter, Crawford, Dent, Franklin, Howell, Oregon, Phelps, Pulaski, St. Francois, Shannon, and Wayne Counties supplied the iron ore output of Missouri in 1938. The ore, which averaged 51.33 percent iron, comprised both hematite and brown ore, was mined from open-pit and underground operations and was shipped to cement, paint, and steel plants.

*New Jersey.*—Output of iron ore in New Jersey decreased in 1938 from 1937 and totaled 185,639 tons. The ore, all magnetite and all produced from underground operations, came from three mines in Morris County in the northern part of the State. New Jersey ores are crushed and concentrated before shipment. The bulk of the

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concentration is done magnetically, although some nonmagnetic martite is recovered by gravity methods, and some hand-sorting is practiced, principally to recover high-grade lump used in open-hearth steel furnaces. The concentrates produced in 1938 averaged (natural) 63.24 percent iron. The largest output came from the Mt. Hope mine of the Warren Foundry & Pipe Corporation. The ore hoisted from this mine is hand-sorted and milled; the concentrates from the mill in 1938 averaged (natural) 63.16 percent iron. Other producers were the Scrub Oaks, which was idle most of the year, and Richard mines.

*New Mexico.*—One operation in New Mexico produced 1,826 gross tons of magnetite, carrying (natural) 61.11 percent iron in 1938. The ore was shipped to nonferrous smelters for fluxing purposes.

*New York.*—The production of iron ore in New York in 1938 was chiefly magnetite from underground operations at the Harmony and Old Bed shafts in Essex County and the Chateaugay mine in Clinton County. Some hematite was mined for paint in Oneida and Wayne Counties. Shipments from New York in 1938 included sinter averaging 67 percent iron, lump averaging 61 percent iron, and concentrates averaging 68 percent iron.

The largest producer was the Republic Steel Corporation, which operates properties at Mineville near Port Henry.

The other large producer in New York (the Chateaugay Ore & Iron Co. at Lyon Mountain) produces both for its own consumption and for sale.

*Pennsylvania.*—Pennsylvania is the most important source of magnetite in the United States. The output comes from the Cornwall mine in Lebanon County, where the ore is extracted by both open-pit and underground methods. In addition, some carbonate ore for use in paint was mined in Carbon County in 1938. A description of the operations at the Cornwall deposit has been given by Yaklish.[18]

*Tennessee.*—The output and shipments of iron ore in 1938 came from two mines (one in Hickman County and one in Lewis County), contained 47.15 percent iron, and were all brown ore.

In addition, considerable sintered pyrite ash was made at the plants of the Tennessee Copper Co. in Ducktown Basin. This sinter, which contained 66.6 percent iron and 0.005 percent phosphorus in 1938, moved largely to the blast furnaces in the Birmingham district, where it was added to the blast-furnace burden. Such sinter is not included in iron ore production or shipment figures for the United States. The situation regarding iron ores and the iron industries of the Tennessee Valley region has been outlined by Eckel.[19]

*Texas.*—There has been no commercial production of iron ore in Texas since 1921, but extensive deposits are known to exist. The following is a summary of a bulletin published by the Federal Geological Survey regarding deposits in eastern Texas.[20]

The brown iron ore or limonite deposits described in this report occupy parts of the Coastal Plain province in eastern Texas. Ferruginous material is widely distributed, but the most promising deposits occupy small parts of Cass, Cherokee,

[18] Yaklish, J. P., The Iron Ore Deposit of Cornwall, Pa.: Explosives Eng., vol. 16, No. 11, November. 1938. pp. 327–333.

[19] Eckel, E. C., Iron Ores and Iron Industries of the Tennessee Valley Region: Tennessee Valley Authority Geologic Bull. 10, part 1, April 1938, pp. 1–17.

[20] Eckel, E. B., The Brown Iron Ores of Eastern Texas: Geol. Survey Bull. 902, 1938, pp. 1–157.

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Marion, and Morris Counties. Since 1855 nearly 700,000 tons of ore has been produced. In the northern part of the field the ore occurs as nodules or thin lenses associated with more or less thoroughly weathered Weches greensand, of Eocene age. Farther south the ore forms one solid and nearly continuous bed at the top of the Weches. Chemical and other considerations indicate that the brown ore is derived from the greensand by weathering processes and that the two chief types of ore are due to differences in character of the parent greensand and to different ground-water conditions. Between 150,000,000 and 200,000,000 tons of comparatively high-grade ore is apparently available. These figures do not take into account an enormous tonnage of low-grade material that might possibly be used many years hence. The future of the district appears to depend largely on the solution of transportation problems. The report contains many analyses of the ores and detailed descriptions of all the important deposits. Geologic maps of parts of Cass, Marion, Morris, Cherokee, and Henderson Counties show the distribution and classification of the ores.

*Utah.*—Two operators in Iron County supplied the Utah total in 1938. By far the larger output came from the Iron Mountain mine, while a relatively small quantity came from the Great Western mine. The ore, principally semialtered magnetite, contained (natural) 54.11 percent iron and moved largely to the blast furnace at Provo, Utah, although small quantities went to steel plants and cement plants.

*Virginia.*—The output of iron ore in Virginia is small. All of the 1938 production was brown ore from Botetourt County and averaged (natural) about 53 percent iron. The ore was used chiefly in the manufacture of hydrogen gas.

*Washington.*—One open-pit and one underground mine produced the total output of Washington in 1938. The two mines—the Napoleon in Stevens County and the Keystone in Pend Oreille County—yielded hematite, averaging (natural) 39.41 percent iron, which was used for cement manufacture.

*Wisconsin.*—The Montreal mine, an underground operation in Iron County, was the larger producer of iron ore in Wisconsin, contributing 796,780 gross tons of the 854,795 produced in 1938. The ore—hematite—averaged (natural) 53.11 percent iron, 0.98 percent manganese, and 0.058 percent phosphorus. The Cary mine, also an underground operation in Iron County, was the other producer in 1938, furnishing 58,015 tons of hematite containing (natural) 55.39 percent iron, 0.39 percent manganese, and 0.043 percent phosphorus. Shipments from Wisconsin mines totaled 625,378 tons in 1938.

*Wyoming.*—The output of iron ore from Wyoming in 1938 came from the Sunrise mine and comprised 275,995 gross tons of hematite containing (natural) about 53 percent iron and 0.064 percent manganese. Much of the ore is a red, earthy hematite similar to Mesabi ore. Production came from open-pit and underground operations. Block-caving methods in use at this mine have been described by Rupp.[21]

[21] Rupp, G. H., Block-caving at the Sunrise Iron Mine, Wyoming: Am. Inst. Min. and Met. Engr. Tech. Paper 1069, February 1939, pp. 1–16.

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*Iron ore mined in the United States, 1937–38, by States and counties*

[Exclusive of ore containing 5 percent or more manganese]

| State and county | 1937 | | 1938 | |
|---|---|---|---|---|
| | Active mines | Gross tons | Active mines | Gross tons |
| Alabama: | | | | |
| Bibb and Tuscaloosa | [1] 4 | 150,479 | 3 | 143,736 |
| Blount | 2 | 77,811 | 2 | 31,764 |
| Butler, Conecuh, and Crenshaw | 5 | 5,003 | 2 | 1,509 |
| Calhoun | [2] | 4,702 | 5 | 21,378 |
| Cherokee | [1] 4 | 17,642 | 5 | 12,826 |
| Chilton | [1] 2 | 24,499 | 2 | 5,559 |
| Clay | 2 | 435 | ------ | ------ |
| Cleburne | 1 | 1,240 | 2 | 2,138 |
| Coosa | 1 | 2,266 | 1 | 47 |
| De Kalb | 1 | 161 | ------ | ------ |
| Etowah | 2 | 3,740 | 1 | 77 |
| Franklin | 3 | 308,060 | 2 | 101,790 |
| Jefferson | 5 | 5,688,768 | 6 | 3,970,604 |
| St. Clair | [2] | 10,301 | 3 | 233 |
| Shelby | 2 | 11,377 | 2 | 4,417 |
| Talladega | [2] | 1,097 | 1 | 7,251 |
| | [3] 34 | 6,307,581 | 37 | 4,303,329 |
| California: | | | | |
| Placer | 1 | 247 | ------ | ------ |
| San Bernardino | 2 | | 1 | 28,380 |
| Inyo | ------ | ------ | 1 | |
| Santa Cruz | ------ | ------ | 1 | |
| | 3 | 247 | 3 | 28,380 |
| Georgia: | | | | |
| Bartow | [1] 3 | 13,522 | 3 | 9,176 |
| Polk | [1] 4 | 976 | 1 | 45 |
| | [3] 7 | 14,498 | 4 | 9,221 |
| Michigan: | | | | |
| Dickinson | 3 | 480,391 | 3 | 270,777 |
| Gogebic | 10 | 4,160,575 | 10 | 2,034,035 |
| Iron | 13 | 1,812,648 | 12 | 1,012,786 |
| Marquette | 15 | 5,631,434 | 14 | 2,686,713 |
| | 41 | 12,085,048 | 39 | 6,004,311 |
| Minnesota: | | | | |
| Crow Wing | 7 | 631,827 | 4 | 260,194 |
| Itasca | 26 | 10,885,586 | 17 | 3,603,483 |
| St. Louis | 51 | 36,899,572 | 34 | 10,585,627 |
| | 84 | 48,416,985 | 55 | 14,449,304 |
| Mississippi: Lafayette | 1 | 97 | ------ | ------ |
| Missouri: | | | | |
| Butler, Carter, Crawford, Howell, Pulaski, Shannon, and Wayne | [4] | 18,000 | [5] 10 | 25,995 |
| Phelps | 1 | 114 | | |
| Dent | 2 | 1,550 | 1 | 1,135 |
| Franklin | ------ | ------ | 1 | 1,200 |
| Oregon | 1 | 291 | ------ | ------ |
| St. Francois | ------ | ------ | 1 | 214 |
| | [3] 4 | 19,955 | [3] 13 | 28,544 |
| Nevada: Lyon | 1 | 196 | ------ | ------ |
| New Jersey: | | | | |
| Morris | 3 | 520,133 | 3 | 185,639 |
| Warren | 2 | | ------ | ------ |
| | 5 | 520,133 | 3 | 185,639 |
| New Mexico: | | | | |
| Grant | 3 | 10,426 | 1 | 1,826 |
| New York: | | | | |
| Essex | 1 | 2,624,512 | 1 | 2,120,823 |
| Clinton | 1 | | 1 | |
| Oneida | 1 | | 1 | |
| Wayne | 1 | | 1 | |
| | 4 | | 4 | |
| Pennsylvania: | | | | |
| Lebanon | 1 | | 1 | |
| Carbon | 1 | 532 | 1 | 448 |
| | 2 | 2,625,044 | 2 | 2,121,271 |
| Utah: Iron | 2 | 190,908 | 2 | 167,933 |
| Tennessee: | | | | |
| Dickson | 1 | 28,359 | ------ | ------ |
| Lawrence | 1 | | ------ | ------ |
| Montgomery | 1 | | ------ | ------ |
| Hickman | 1 | | 1 | 13,179 |
| Lewis | 1 | | 1 | |
| | 5 | 28,359 | 2 | |
| Virginia: | | | | |
| Botetourt | 1 | 518 | 2 | |
| | 1 | 518 | 2 | 13,179 |
| Washington: | | | | |
| Okanogan | 1 | 983 | ------ | ------ |
| Pend Oreille | 1 | 1,227 | 1 | 1,730 |
| Stevens | 2 | 7,834 | 1 | 1,825 |
| | 4 | 10,044 | 2 | 3,555 |
| Wisconsin: | | | | |
| Dodge | 1 | 500 | ------ | ------ |
| Iron | 2 | 1,155,102 | 2 | 854,795 |
| | 3 | 1,155,602 | 2 | 854,795 |
| Wyoming: | | | | |
| Platte | 1 | 707,907 | 1 | 275,995 |
| | [3] 205 | 72,093,548 | [3] 172 | 28,447,282 |

[1] In addition, an undetermined number of small pits: Alabama—5 shippers in Bibb and Tuscaloosa Counties, 5 in Cherokee County, and 6 in Chilton County; Georgia—9 shippers in Bartow County and 5 in Polk County. The output from these pits is included in the tonnage given.

[2] Undetermined number of small pits: 17 shippers in Calhoun County, 5 in St. Clair County, and 6 in Talladega County.

[3] Excludes an undetermined number of small pits. The output of these pits is included in the tonnage given.

[4] Undetermined number of small pits operated by 1 producer.

[5] In addition, an undetermined number of small pits. The output of these pits is included in the tonnage given.

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## MEN EMPLOYED AND OUTPUT PER MAN AT MINES

Although complete information on employment at iron ore mines in 1938 is not yet available, nearly complete figures indicate that about 19,700 men working 30,388,000 man-hours were required to produce 28,447,282 tons of merchantable ore, an average of 0.936 ton per man-hour. Thus, the total man-hours worked in 1938 declined 41 percent from 1937, whereas the output of merchantable ore decreased 61 percent; in consequence, output per man-hour was 33 percent less. The decline in the output per man-hour in 1938 compared with 1937 was due mainly to a shift in the production of ore from open-pit to underground mines. Specifically, about half the output came from open-pit mines in 1938 compared with about two-thirds in 1937.

During 1937, the last year for which complete statistics are available, near-record output of iron ore resulted in an increase in labor at the

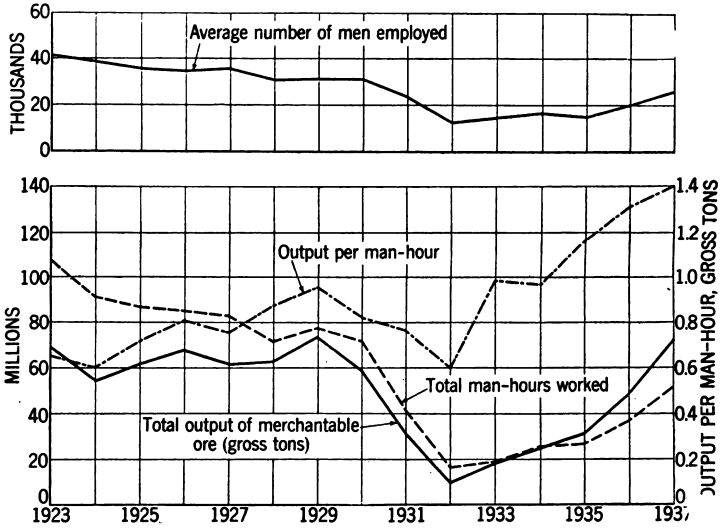


FIGURE 3.—Trends in number of men employed at iron ore mines, output of merchantable ore, man-hours worked, and output per man-hour in the United States, 1923–37.

mines. The average number of men increased, as did the average number of days worked, but the increase in man-hours did not parallel the increase in output, and as a result the output per man-hour again increased. In 1937, 25,945 men working 51,416,193 man-hours produced 72,093,548 tons of merchantable ore, an average output of 1.402 tons per man-hour, while in 1936, 20,306 men working 37,246,583 man-hours produced 48,788,745 tons of merchantable ore, or 1.310 tons per man-hour. Thus, while the average number of men employed increased 28 percent from 1936 to 1937 and the number of man-hours increased 38 percent, the output of merchantable ore increased 48 percent, resulting in an increase of 7 percent in the output per man-hour. The output per man-hour in 1937 exceeded that for any year since records have been compiled and undoubtedly was greater than in any other year. The relatively smaller labor require-

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ments in 1937 than in 1936 resulted from several factors—proportionately larger outputs from open-pit mines and of direct shipping ore, nearer capacity production of operating units, and an increase in the number of days worked. Conversely, the stripping per ton of open-pit ore increased, but apparently this factor was overshadowed by the items listed above.

The number of man-hours of labor increased in all districts in 1937 over 1936, but the increase was relatively less in the Lake Superior district than in the other chief producing districts. In the Lake Superior district the output of merchantable ore per man-hour continued to increase, reaching 1.779 tons in 1937—11 percent more than in 1936. Despite the greater productivity, the large gain in output in 1937 over 1936—19,876,420 tons (48 percent)—required employment of only 26 percent more men; this, plus a small increase in the average number of days worked, caused a rise of 33 percent in the number of man-hours worked. Much of the Lake Superior output comes from Minnesota, where open pits furnished 88 percent of the ore in 1937. Because of this preponderant production from open pits, output per man-hour in Minnesota is greater than in any other State or district and in 1937 amounted to 2.479 tons, an increase of 11 percent over 1936. Although, as was pointed out in Minerals Yearbook, 1934 (p. 322), the improved performance in mining iron ore has been closely related to advances in mechanization, better mining methods, operation of larger units, and more efficient management of mines, the gain in the 5-year period 1933–37 compared with the 10-year period 1923–32 was due chiefly to the expansion of open-pit operations in Minnesota. For example, while about 75 percent of the merchantable ore produced in Minnesota from 1923 to 1932 came from open-pit mines, 86 percent was so produced in 1933–37. The significance of this shift can be appreciated when it is recalled that Minnesota contributed more than 61 percent of the total merchantable ore produced in 1923–37 and that during that period the output of men in open-pit operations averaged 2.029 tons per man-hour compared with only 0.696 ton per man-hour for workers at underground mines.

The greater output per man-hour in recent years also was due in part to the stripping of proportionately less overburden in Minnesota in 1933–37 in preparation for future mining than in 1923–32. In 1933–37 about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined in Itasca and St. Louis Counties, Minn., whereas in 1923–32 about one-half cubic yard of overburden was removed for each ton of merchantable ore mined. Any material shift in the labor force used for direct mining of the ore at the expense of that used in stripping will result in a much lower man-hour cost of mining for any year. This is illustrated strikingly in figure 4, which shows that in 1926, 1933, 1935, 1936, and 1937, when only about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined at both open-pit and underground mines, the output per worker increased substantially, whereas during the other years, when one-third to four-fifths cubic yard of overburden was removed for each ton of ore mined, the output per worker decreased.

Another factor that affects the output per man-hour is the tendency to mine leaner ore. Proportionately more lean ore requiring beneficia-

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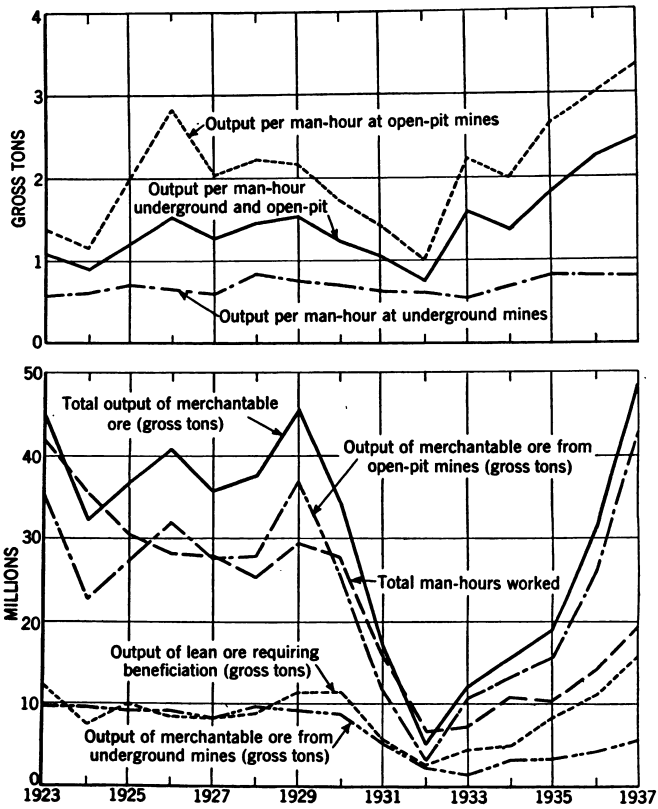


FIGURE 4.—Trends in output of merchantable iron ore per man-hour at open-pit mines in Minnesota compared with production of merchantable and lean ore and total man-hours worked, 1923–37.

tion has been mined in Minnesota in recent years than during the period 1923–32. In 1933–37, for instance, beneficiated ore represented 21 percent of the total merchantable ore compared with an average of only 16 percent in 1923–32.

The bulk of the ore in the Southeastern district, the second largest producing region, is obtained from underground operations. Output of merchantable ore per man-hour in this area increased to 0.624 ton in 1937 from 0.582 ton in 1936. The largest and most consistent producing mines in the Southeastern district are in Jefferson County, Ala., where 4,030 men working 8,418,520 man-hours in 1937 produced 5,688,768 tons of merchantable ore, equivalent to an average output of 0.676 ton per man-hour. Virtually all ore produced in Jefferson County comes from underground operations. In comparing the man-hour cost of mining ore in Jefferson County, Ala., with that at underground mines in the Lake Superior district one should remember that whereas the ore in the Lake Superior district is considerably richer in iron, the ore from the Jefferson County mines contains enough or almost enough lime to make it self-fluxing. Thus, it should be recognized that the lower iron content is partly offset by the self-fluxing

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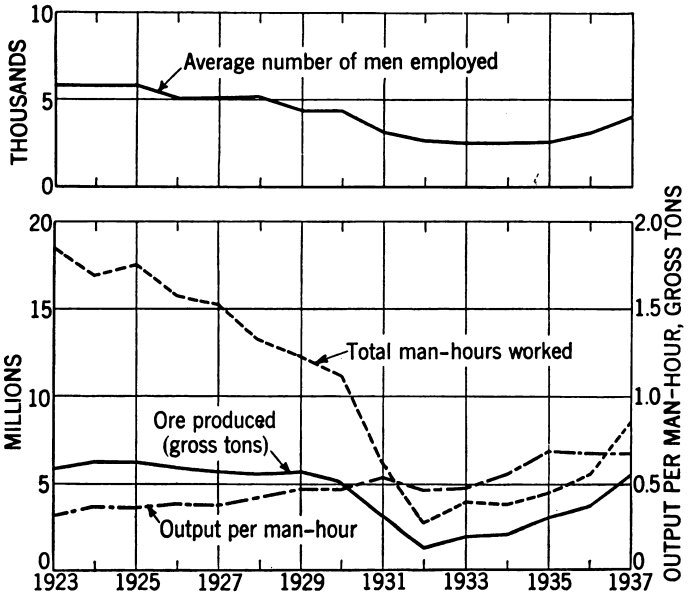


FIGURE 5.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923-37.

nature of the ore, although it is impossible to show this important characteristic in the productivity figures.

In the Northeastern district the average output of merchantable ore per man-hour decreased to 0.523 ton in 1937 from 0.603 ton in 1936. The drop in productivity was due in part to relatively larger increases in output from mines in New Jersey and New York, where virtually the entire output came from underground operations, resulting in a relatively higher expenditure of labor than in Pennsylvania, where output is predominantly from the open pit at Cornwall and productivity is high.

The following table shows employment at iron mines and beneficiating plants, quantity and tenor of ore produced, and average output per man by districts and States in 1937. Corresponding statistics and supplementary data are given in Minerals Yearbook, 1934 to 1938, inclusive.

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*Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1937, by districts and States*

[Exclusive of ore containing 5 percent or more manganese]

| District and State | Employment | | | | | Production | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Time employed | | | | | Merchantable ore | | | Average per man (gross tons) | | | | | |
| | | | | Man-hours | | | | Iron contained | | Crude ore (partly estimated) | | Merchantable ore | | | |
| | Average number of men employed | Average number of days | Total man-shifts | Average per shift | Total | Crude ore (partly estimated), gross tons | Gross tons | Gross tons | Percent natural | Per shift | Per hour | Per shift | Per hour | Iron contained Per shift | Iron contained Per hour |
| Lake Superior: | | | | | | | | | | | | | | | |
| Michigan | 6,838 | 252 | 1,725,079 | 8.0 | 13,804,353 | 12,085,048 | 12,085,048 | 6,224,379 | 51.50 | 7.006 | 0.875 | 7.006 | 0.875 | 3.608 | 0.451 |
| Minnesota | 10,372 | 235 | 2,434,168 | 8.0 | 19,531,053 | 54,650,865 | 48,416,985 | 25,096,045 | 51.83 | 22.452 | 2.798 | 19.891 | 2.479 | 10.310 | 1.285 |
| Wisconsin | 626 | 262 | 164,203 | 8.0 | 1,313,634 | 1,155,602 | 1,155,602 | 617,846 | 53.47 | 7.038 | .880 | 7.038 | .880 | 3.763 | .470 |
| | 17,836 | 242 | 4,323,450 | 8.0 | 34,649,040 | 67,891,515 | 61,657,635 | 31,938,270 | 51.80 | 15.703 | 1.959 | 14.261 | 1.779 | 7.387 | .922 |
| Southeastern: | | | | | | | | | | | | | | | |
| Alabama | 4,906 | 253 | 1,242,651 | 8.1 | 10,024,673 | 7,600,938 | 6,307,581 | 2,317,993 | 36.75 | 6.117 | .758 | 5.076 | .629 | 1.865 | .231 |
| Georgia | | | | | | | 14,498 | 5,517 | 38.05 | | | | | | |
| Mississippi | 226 | 71 | 16,024 | 9.9 | 159,022 | 73,267 | 97 | 45 | 46.68 | 4.572 | .461 | 2.713 | .273 | 1.129 | .114 |
| Tennessee | | | | | | | 28,359 | 12,301 | 43.38 | | | | | | |
| Virginia | | | | | | | 518 | 233 | 45.00 | | | | | | |
| | 5,132 | 245 | 1,258,675 | 8.1 | 10,183,695 | 7,674,205 | 6,351,053 | 2,336,089 | 36.78 | 6.097 | .754 | 5.046 | .624 | 1.856 | .229 |
| Northeastern: | | | | | | | | | | | | | | | |
| New Jersey | 733 | 262 | 191,908 | 8.0 | 1,539,992 | 969,747 | 520,133 | 323,050 | 62.11 | 5.053 | .630 | 2.710 | .338 | 1.683 | .210 |
| New York | 1,882 | 293 | 551,790 | 8.1 | 4,475,350 | 3,430,934 | 2,625,044 | 1,314,386 | 67.20 | 6.218 | .767 | 4.757 | .587 | 2.382 | .294 |
| Pennsylvania | | | | | | | | | 40.79 | | | | | | |
| | 2,615 | 284 | 743,698 | 8.1 | 6,015,342 | 4,400,681 | 3,145,177 | 1,637,436 | 52.06 | 5.917 | .732 | 4.229 | .523 | 2.202 | .272 |
| Western: | | | | | | | | | | | | | | | |
| California | | | | | | 247 | 247 | 127 | 51.42 | | | | | | |
| Missouri | | | | | | 19,955 | 19,955 | 10,825 | 54.25 | | | | | | |
| Nevada | 126 | 167 | 20,988 | 8.0 | 167,959 | 196 | 196 | 127 | 65.00 | 11.043 | 1.380 | 11.043 | 1.380 | 5.967 | .746 |
| New Mexico | | | | | | 10,426 | 10,426 | 5,861 | 56.22 | | | | | | |
| Utah | | | | | | 190,908 | 190,908 | 104,051 | 54.50 | | | | | | |
| Washington | | | | | | 10,044 | 10,044 | 4,249 | 42.30 | | | | | | |
| Wyoming | 236 | 212 | 50,020 | 8.0 | 400,157 | 707,907 | 707,907 | 373,776 | 52.80 | 14.152 | 1.769 | 14.152 | 1.769 | 7.473 | .934 |
| | 362 | 196 | 71,008 | 8.0 | 568,116 | 939,683 | 939,683 | 499,016 | 53.10 | 13.233 | 1.654 | 13.233 | 1.654 | 7.028 | .878 |
| | 25,945 | 247 | 6,396,831 | 8.0 | 51,416,193 | 80,906,084 | 72,093,548 | 36,410,811 | 50.50 | 12.648 | 1.574 | 11.270 | 1.402 | 5.692 | .708 |

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## WORLD PRODUCTION

The following table shows the production of iron ore by countries from 1934 to 1938, insofar as statistics are available. Complete returns for 1938 are not yet available, but the data for 1937 are nearly complete. Output in 1937 was larger than in any other year, amounting to 213,700,000 metric tons, of which the United States supplied 34 percent. World production was lower in 1938, the curtailment amounting to about 25 percent.

*Iron ore produced, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | | | |
| Cuba (shipments) | 181,121 | 228,408 | 456,827 | 496,258 | 154,540 |
| Guatemala | | | | 101 | [2] |
| Mexico | 105,799 | 95,590 | 123,121 | 136,018 | 118,251 |
| Newfoundland | 514,747 | 677,137 | 907,646 | 1,635,554 | 1,707,180 |
| United States | 24,982,047 | 31,030,423 | 49,571,804 | 73,250,649 | 28,903,861 |
| South America: | | | | | |
| Brazil (exports) | 7,138 | 47,184 | 110,997 | 209,715 | 359,115 |
| Chile [3] | 969,285 | 841,300 | 1,347,831 | 1,489,637 | 1,608,399 |
| Europe: | | | | | |
| Belgium | 115,890 | 164,520 | 190,660 | 265,540 | [2] |
| Bulgaria | | 2,370 | 6,498 | 11,920 | 16,771 |
| Czechoslovakia | 538,742 | 731,058 | 1,089,623 | 1,836,495 | [2] |
| France | 32,015,150 | 32,045,900 | 33,301,620 | 37,839,000 | 33,137,000 |
| Germany [4] | 4,213,869 | 5,851,634 | 7,339,836 | 9,575,234 | 10,938,650 |
| Austria | 466,835 | 775,421 | 1,024,288 | 1,884,694 | 2,647,000 |
| Greece | 147,408 | 204,146 | 280,271 | 300,498 | [2] |
| Hungary | 68,870 | 192,396 | 279,673 | 289,520 | 370,000 |
| Italy | 484,583 | 551,454 | 838,833 | 997,805 | [2] |
| Luxemburg | 3,833,847 | 4,133,808 | 4,895,992 | 7,766,254 | 5,048,965 |
| Norway | 567,414 | 765,152 | 846,809 | 1,008,225 | 1,400,000 |
| Poland | 247,365 | 332,536 | 466,659 | 780,152 | 872,591 |
| Portugal | 2,895 | 880 | 6,539 | 7,700 | [2] |
| Rumania | 83,590 | 93,813 | 108,549 | 129,005 | [2] |
| Spain | 2,094,001 | 2,633,165 | [5] | 990,000 | 2,513,000 |
| Sweden | 5,253,058 | 7,932,854 | 11,249,605 | 14,952,549 | [2] |
| Switzerland (exports) | 18,961 | 5,894 | 31,833 | 148,578 | 133,998 |
| U. S. S. R. [6] | 21,508,800 | 26,845,000 | 27,918,000 | 26,000,000 | [7] 27,000,000 |
| United Kingdom: Great Britain [8] | 10,756,765 | 11,070,256 | 12,905,243 | 14,443,146 | 12,049,540 |
| Yugoslavia | 179,841 | 234,729 | 450,859 | 629,172 | 606,884 |
| Asia: | | | | | |
| Burma | 24,314 | 23,456 | 26,738 | 25,834 | [2] |
| China [9] | 2,544,613 | [5] | [5] | [5] | [2] |
| Chosen | 176,008 | 228,220 | 234,400 | 207,500 | [2] |
| India, British | 1,923,370 | 2,378,788 | 2,567,488 | 2,916,909 | 2,885,357 |
| Indochina | 1,500 | 635 | 10,017 | 33,285 | [2] |
| Japan | 431,681 | 515,529 | 754,400 | [5] | [2] |
| Malay States: | | | | | |
| Federated Malay States | | | 457 | 1,165 | 938 |
| Unfederated Malay States | 1,153,876 | 1,434,293 | 1,681,102 | 1,686,990 | [2] |
| Philippine Islands (exports) | 7,239 | 283,311 | 654,458 | 601,190 | 910,952 |
| U. S. S. R. | [6] | [6] | [6] | [6] | [6] |
| Africa: | | | | | |
| Algeria | 1,326,437 | 1,674,628 | 1,884,281 | 2,427,230 | 3,105,037 |
| Egypt | 203 | 15 | | | [2] |
| Morocco: | | | | | |
| French | | | | 66,864 | 266,100 |
| Spanish | 824,812 | 1,167,606 | 1,052,988 | 1,420,000 | 1,341,658 |
| Northern Rhodesia | | | 2 | 528 | 208 |
| Sierra Leone | 233,148 | 440,498 | 575,689 | 644,160 | [2] |
| South-West Africa | | | | 14,280 | [2] |
| Tunisia | 546,500 | 503,000 | 750,000 | 943,763 | 821,630 |
| Union of South Africa | 233,175 | 304,048 | 364,981 | 461,796 | 505,314 |
| Oceania: | | | | | |
| Australia: | | | | | |
| New South Wales | | 7,785 | | | [2] |
| Queensland | 3,282 | 1,137 | 2,338 | 4,551 | 5,207 |
| South Australia | 1,264,205 | 1,898,712 | 1,917,589 | 1,896,370 | 2,281,404 |
| Tasmania | | | | 62 | [2] |
| New Zealand | 2,851 | 10,817 | | 580 | 1,238 |
| | 120,100,000 | 140,900,000 | 173,300,000 | 213,700,000 | [2] |

[1] In addition to the countries listed Finland, Madagascar, and Turkey report production of iron ore, but complete data are not available. [2] Data not yet available. [3] Production of Tofo mines.
[4] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese. [5] Estimate included in total.
[6] Russia in Asia included with Russia in Europe. [7] Includes manganiferous iron ore.
[8] Exclusive of bog ore, which is used mainly for the purification of gas. [9] Including Manchuria.

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## PIG IRON

*Production and shipments.*—Domestic production of pig iron, exclusive of ferro-alloys, decreased 49 percent in 1938 from 1937 and was the lowest since 1934. The output in 1938 comprised 18,543,391 gross tons using coke and 38,931 tons using charcoal as fuel. Pennsylvania was the largest producer of pig iron in 1938, with 26 percent of the total; and Ohio ranked second, with 23 percent. Of the pig iron manufactured in 1938 it is calculated that 890,444 tons valued at $15,488,069 were made from 1,507,584 tons of foreign ores, including ore from Africa, Asia, Australia, Brazil, Chile, Cuba, Sweden, and the U. S. S. R., indicating an average yield of 59.06 percent from imported ore. Domestic ore (30,866,250 tons) and cinder, scale, and purchased scrap (2,571,633 tons) totaling 33,437,883 tons were reported used in the manufacture of 17,691,878 tons of pig iron, indicating an average pig-iron yield of 52.91 percent from domestic materials. In addition, 763,832 tons of home scrap and 951,000 tons of flue dust were consumed in making pig iron in 1938.

Shipments of pig iron, exclusive of ferro-alloys, in 1938, were 48 percent below 1937 and the lowest since 1934. The total value of shipments decreased 51 percent. The values given represent the approximate amounts received for the iron f.o.b. furnaces and do not include freight costs, selling commissions, and other items that are figured in some of the market prices of pig iron published by trade journals.

*Pig iron produced and shipped in the United States, 1937–38, by States*

| State | Produced | | Shipped from furnaces | | | |
|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | | 1938 | |
| | Gross tons | Gross tons | Gross tons | Value | Gross tons | Value |
| Alabama | 2,580,674 | 2,023,269 | 2,528,785 | $42,188,993 | 1,990,342 | $29,190,091 |
| Colorado | (1) | (1) | (1) | (1) | (1) | (1) |
| Illinois | 3,426,480 | 1,656,591 | 3,357,959 | 70,893,278 | 1,519,572 | 30,899,012 |
| Indiana | 3,773,887 | 1,791,085 | 3,694,360 | 77,990,597 | 1,807,808 | 37,025,980 |
| Iowa | (1) | (1) | (1) | (1) | (1) | (1) |
| Kentucky | 243,010 | 126,102 | 243,010 | (1) | 126,102 | (1) |
| Maryland | 1,554,296 | 1,201,374 | 1,514,372 | (1) | 1,219,611 | (1) |
| Massachusetts | (1) | | (1) | (1) | (1) | (1) |
| Michigan | 948,429 | 556,230 | 886,602 | 15,064,083 | 558,782 | 9,806,994 |
| Minnesota | 253,942 | (1) | 248,363 | (1) | 135,931 | (1) |
| New York | 2,723,411 | 1,338,907 | 2,702,072 | 55,789,609 | 1,222,832 | 25,450,764 |
| Ohio | 7,917,215 | 4,210,514 | 7,724,882 | 167,076,855 | 4,186,217 | 85,186,824 |
| Pennsylvania | 11,371,238 | 4,836,093 | 11,036,467 | 239,838,942 | 4,684,017 | 101,266,844 |
| Tennessee | (1) | (1) | (1) | (1) | (1) | (1) |
| Utah | (1) | (1) | (1) | (1) | (1) | (1) |
| Virginia | (1) | (1) | (1) | (1) | (1) | (1) |
| West Virginia | 722,531 | 472,738 | 685,086 | (1) | 496,905 | (1) |
| Undistributed | [2] 629,982 | [2] 369,419 | [2] 602,389 | [2] 62,297,078 | [2] 254,235 | [2] 38,048,860 |
| | 36,145,095 | 18,582,322 | 35,224,347 | 731,139,435 | 18,202,354 | 356,875,369 |

[1] Included under "Undistributed."
[2] Includes statistics for States entered as "(1)."

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*Pig iron shipped from blast furnaces in the United States, 1937–38, by grades*

| Grade | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Gross tons | Value | | Gross tons | Value | |
| | | Total | Average | | Total | Average |
| Charcoal | 76,790 | $1,879,333 | $24.47 | 26,558 | $657,885 | $24.77 |
| Foundry | 2,811,235 | 56,679,060 | 20.16 | 1,538,349 | 28,308,696 | 18.40 |
| Basic | 24,676,914 | 498,478,989 | 20.20 | 13,058,455 | 250,310,020 | 19.17 |
| Bessemer | 5,328,499 | 120,288,914 | 22.57 | 2,611,015 | 56,680,050 | 21.71 |
| Low-phosphorus | 244,135 | 6,348,612 | 26.00 | 120,195 | 2,830,256 | 23.55 |
| Malleable | 1,994,022 | 45,123,949 | 22.63 | 765,780 | 16,489,173 | 21.53 |
| Forge | 23,838 | 515,730 | 21.63 | 1,347 | 27,653 | 20.53 |
| All other (not ferro-alloys) | 68,914 | 1,824,848 | 26.48 | 80,655 | 1,571,636 | 19.49 |
| | 35,224,347 | 731,139,435 | 20.76 | 18,202,354 | 356,875,369 | 19.61 |

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1937 and 1938, exclusive of electric reduction furnaces, were as follows:

*Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1937–38*[1]

| State | In blast June 30, 1937 | Dec. 31, 1937 | | | In blast June 30, 1938 | Dec. 31, 1938 | | |
|---|---|---|---|---|---|---|---|---|
| | | In | Out | Total | | In | Out | Total |
| Alabama | 18 | 11 | 9 | 20 | 6 | 16 | 4 | 20 |
| Colorado | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 3 |
| Illinois | 16 | 7 | 16 | 23 | 4 | 9 | 14 | 23 |
| Indiana | 14 | 7 | 11 | 18 | 5 | 8 | 11 | 19 |
| Kentucky | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| Maryland | 6 | 3 | 3 | 6 | 4 | 5 | 1 | 6 |
| Massachusetts | 1 | | 1 | 1 | | | 1 | 1 |
| Michigan | 7 | 5 | 2 | 7 | 4 | 5 | 3 | 8 |
| Minnesota | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| Missouri | | | 1 | 1 | | | 1 | 1 |
| New York | 14 | 8 | 11 | 19 | 5 | 9 | 8 | 17 |
| Ohio | 36 | 20 | 28 | 48 | 17 | 29 | 19 | 48 |
| Pennsylvania | 62 | 28 | 53 | 81 | 20 | 29 | 49 | 78 |
| Tennessee | 1 | 1 | 4 | 5 | 1 | | 3 | 3 |
| Utah | 1 | 1 | | 1 | 1 | 1 | | 1 |
| Virginia | 1 | | 1 | 1 | 1 | 1 | | 1 |
| West Virginia | 3 | 1 | 2 | 3 | 1 | 1 | 2 | 3 |
| | 187 | 95 | 146 | 241 | 73 | 116 | 120 | 236 |

[1] American Iron and Steel Institute.

*Value at blast furnaces.*—The average value of all kinds of pig iron given in the accompanying table is based on reports of manufacturers to the Bureau of Mines. The figures represent the approximate values f. o. b. blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces was $19.61 a gross ton in 1938—$1.15 less than in 1937.

*Average value per gross ton of pig iron at blast furnaces in the United States, 1934–38*

| State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Alabama | $13.81 | $14.67 | $15.01 | $16.68 | $14.67 |
| Illinois | 17.72 | 17.58 | 18.24 | 21.11 | 20.33 |
| Indiana | 17.60 | 17.78 | 18.14 | 21.11 | 20.48 |
| Michigan | 15.49 | 15.64 | 15.56 | 16.99 | 17.55 |
| New York | 15.20 | 15.95 | 15.87 | 20.65 | 20.81 |
| Ohio | 16.45 | 16.70 | 17.02 | 21.63 | 20.35 |
| Pennsylvania | 18.06 | 18.38 | 18.82 | 21.73 | 21.62 |
| Other States [1] | 15.75 | 14.46 | 17.50 | 18.92 | 17.04 |
| Average for United States | 16.73 | 16.91 | 17.59 | 20.76 | 19.61 |

[1] Colorado, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Utah, Virginia, and West Virginia.

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*Commercial quotations.*—The average monthly prices of foundry, basic, and bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces, according to published market quotations, are summarized in the following table:

*Average monthly prices per ton of chief grades of pig iron, 1937–38* [1]

| Month | Foundry pig iron at Valley furnaces | | Foundry pig iron at Birmingham furnaces | | Bessemer pig iron at Valley furnaces | | Basic pig iron at Valley furnaces | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 |
| January | $21.00 | $24.00 | $17.38 | $20.38 | $21.50 | $24.50 | $20.50 | $23.50 |
| February | 21.13 | 24.00 | 17.41 | 20.38 | 21.63 | 24.50 | 20.63 | 23.50 |
| March | 23.72 | 24.00 | 19.92 | 20.38 | 24.22 | 24.50 | 23.22 | 23.50 |
| April | 24.00 | 24.00 | 20.38 | 20.38 | 24.50 | 24.50 | 23.50 | 23.50 |
| May | 24.00 | 24.00 | 20.38 | 20.38 | 24.50 | 24.50 | 23.50 | 23.50 |
| June | 24.00 | 23.35 | 20.38 | 19.61 | 24.50 | 23.85 | 23.50 | 22.85 |
| July | 24.00 | 20.00 | 20.38 | 16.38 | 24.50 | 20.50 | 23.50 | 19.50 |
| August | 24.00 | 20.00 | 20.38 | 16.38 | 24.50 | 20.56 | 23.50 | 19.50 |
| September | 24.00 | 20.16 | 20.38 | 16.54 | 24.50 | 20.66 | 23.50 | 19.66 |
| October | 24.00 | 21.00 | 20.38 | 17.38 | 24.50 | 21.50 | 23.50 | 20.50 |
| November | 24.00 | 21.00 | 20.38 | 17.38 | 24.50 | 21.50 | 23.50 | 20.50 |
| December | 24.00 | 21.00 | 20.38 | 17.38 | 24.50 | 21.50 | 23.50 | 20.50 |
| Average | 23.49 | 22.21 | 19.84 | 18.58 | 23.99 | 22.71 | 22.99 | 21.71 |

[1] Metal Statistics, 1939.

*Foreign trade.*—Imports of pig iron for consumption in 1938 declined 73 percent from 1937 owing to lower receipts from European nations and British India. The Netherlands supplied 47 percent of the 1938 total.

*Pig iron imported for consumption in the United States, 1934–38, by countries, in gross tons*

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: Canada | 8,984 | 13,771 | 11,603 | 6,638 | 2,656 |
| South America: Chile | 89 | | | | |
| Europe: | | | | | |
| Belgium | 100 | 100 | 973 | | |
| Czechoslovakia | | | 37 | | |
| France | | 50 | | | |
| Germany | 100 | 4,877 | 4,749 | 510 | |
| Netherlands | 65,439 | 48,122 | 60,363 | 28,772 | 14,236 |
| Norway | 1,203 | 2,420 | 2,649 | 875 | 850 |
| Sweden | 991 | 907 | 689 | 600 | 205 |
| U. S. S. R. | | 9,124 | 24,556 | 4,581 | |
| United Kingdom | 600 | 14,500 | 4,354 | 100 | 42 |
| Asia: | | | | | |
| Hong Kong | | | 200 | | |
| India, British | 36,013 | 37,016 | 55,426 | 69,621 | 12,411 |
| Japan | | 50 | | | |
| Kwantung | 969 | | 209 | | |
| | 114,488 | 130,937 | 165,808 | 111,697 | 30,400 |
| Value | $1,465,475 | $1,979,324 | $2,336,236 | $1,701,304 | $598,461 |

Exports of pig iron from the United States in 1938 decreased to 432,851 gross tons from 782,436 in 1937 but were still much higher than normal. Japan (73 percent) and the United Kingdom (9 percent) together took 82 percent of the total.

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*Pig iron exported from the United States, 1937–38, by countries, in gross tons*

| Country | 1937 | 1938 | Country | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | Asia: | | |
| Canada | 5,159 | 4,759 | China | 16,635 | 6,553 |
| Other North America | 1,722 | 506 | Hong Kong | 1,611 | 1,970 |
| South America: | | | Japan | 409,241 | 316,280 |
| Chile | 2,644 | 1,426 | Kwantung | 2,000 | |
| Other South America | 1,216 | 524 | Philippine Islands | 1,099 | 734 |
| Europe: | | | Other Asia | 1,125 | 665 |
| Belgium | 10,703 | 3,349 | Africa: | | |
| Czechoslovakia | 6,255 | 60 | Algeria | | 6,236 |
| France | 14,229 | 12,241 | Egypt | 500 | |
| Germany | 20,992 | 10,075 | Union of South Africa | 3,225 | 1,462 |
| Hungary | | 13,825 | Oceania: New Zealand | | 15 |
| Italy | 10,003 | 6,672 | | 782,436 | 432,851 |
| Netherlands | 2,910 | 610 | Value | $10,403,285 | $7,135,129 |
| Poland and Danzig | 2,448 | 200 | | | |
| Spain | 10,492 | 350 | | | |
| Sweden | 24,148 | 3,603 | | | |
| United Kingdom | 233,218 | 40,615 | | | |
| Other Europe | 861 | 121 | | | |

*Consumption.*—The consumption of pig iron dropped 46 percent in 1938 from 1937. Pig iron, a product of the blast furnace, is a semiraw material and, except for the small quantity used in direct castings (about 1 percent of the total consumption), moves to other type furnaces for further refining or mixing with other required ingredients. In general, it goes to steel-making or iron-making furnaces. By far the larger part is taken to steel-making furnaces (open hearth, bessemer, and electric) for refining and processing into steel. In 1938, as in recent years, about 85 percent of the pig iron was consumed in steel making. The open hearths, however, are taking a proportionately larger share, increasing progressively from 70.7 percent of the total in 1935 to 74.2 percent in 1938, while the bessemer furnaces dropped from 14.1 to 10.5 percent. With direct castings taking about 1 percent of the total, the remaining 14 percent is consumed in iron-making furnaces of which the cupola is by far the most important. The consumption of pig iron by types of furnace for the years 1935 to 1938, inclusive, the period for which data are available, is shown in the following table. Typically, the quantities of pig iron used in these furnaces are supplemented by the addition of ferrous scrap. The proportions of scrap to pig iron used in steel furnaces changed only slightly in 1938 compared with 1937, while the proportion of pig iron in cupola furnaces decreased.

*Consumption of pig iron in the United States, 1935–38, by type of furnace*

| Type of furnace or equipment | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Gross tons | Percent of total | Gross tons | Percent of total | Gross tons | Percent of total | Gross tons | Percent of total |
| Open hearth | 14,575,239 | 70.7 | 21,960,842 | 73.0 | 25,118,216 | 73.8 | 13,729,371 | 74.2 |
| Bessemer | 2,911,719 | 14.1 | 3,635,562 | 12.1 | 3,688,335 | 10.8 | 1,946,048 | 10.5 |
| Electric | 33,186 | .2 | 22,866 | .1 | 44,715 | .1 | 15,893 | .1 |
| Cupola [1] | 2,675,827 | 13.0 | 3,633,720 | 12.1 | 4,195,234 | 12.3 | 2,404,637 | 13.0 |
| Air | 295,008 | 1.4 | 407,038 | 1.3 | 444,988 | 1.3 | 185,514 | 1.0 |
| Brackelsberg | | | | | | | | |
| Crucible | 566 | (2) | 34 | (2) | 43 | (2) | 218 | (2) |
| Puddling | 13,492 | .1 | 30,498 | .1 | 31,489 | .1 | 5,343 | (2) |
| Direct castings [1] | 115,426 | .5 | 408,074 | 1.3 | 533,507 | 1.6 | 217,325 | 1.2 |
| | 20,620,463 | 100.0 | 30,098,634 | 100.0 | 34,056,527 | 100.0 | 18,504,349 | 100.0 |

[1] Some pig iron used in making direct castings included in cupola. [2] Less than 0.05 percent.

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The consumption of pig iron in this country is widespread, and plants using pig iron are situated in all 48 States, in the District of Columbia, and Alaska. As expected from the nature of its use the great concentration of consumption is in the iron and steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas in 1938 used 98 percent of the pig iron, Pennsylvania (the leading consumer) taking nearly 26 percent of the total and Ohio (a close second) 23 percent. Of the consuming areas in 1938 the Southeastern district, including the Birmingham district of Alabama, recorded the smallest decline from 1937—24 percent compared with 53 percent in the Middle Atlantic district and 45 percent in the North Central. In Alabama consumption dropped 23 percent. The following table shows the distribution of pig iron consumption by States from 1935 to 1938, inclusive.

*Consumption of pig iron in the United States, 1935–38, by States and districts*

| State and district | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Consumers | Gross tons | Consumers | Gross tons | Consumers | Gross tons | Consumers | Gross tons |
| Connecticut | 50 | 60,884 | 53 | 79,208 | 58 | 87,912 | 57 | 47,746 |
| Maine | 14 | 6,185 | 16 | 9,257 | 16 | 8,824 | 16 | 4,052 |
| New Hampshire | 13 | | 13 | | 13 | 2,180 | 14 | 1,248 |
| Massachusetts | 84 | 75,991 | 87 | 75,389 | 103 | 98,407 | 98 | 59,774 |
| Rhode Island | 14 | | 13 | 25,983 | 14 | 35,140 | 13 | 14,362 |
| Vermont | 13 | 3,596 | 14 | 3,866 | 14 | 7,086 | 13 | 3,019 |
| Total New England | 188 | 146,656 | 196 | 193,703 | 218 | 239,549 | 211 | 130,201 |
| Delaware | 3 | 144,114 | 6 | 215,460 | 7 | 309,065 | 7 | 199,944 |
| New Jersey | 73 | | 79 | | 81 | | 80 | |
| New York | 173 | 848,061 | 191 | 1,371,661 | 192 | 1,793,421 | 194 | 927,350 |
| Pennsylvania | 325 | 5,452,948 | 341 | 9,074,405 | 348 | 10,578,554 | 345 | 4,781,482 |
| Total Middle Atlantic | 574 | 6,445,123 | 617 | 10,661,526 | 628 | 12,681,040 | 626 | 5,908,776 |
| Alabama | 47 | 912,763 | 50 | 1,453,524 | 59 | 1,802,027 | 59 | 1,395,369 |
| District of Columbia | 2 | 2,441 | 1 | 501 | 1 | 444 | 1 | |
| Kentucky | 17 | 307,037 | 18 | 1,489,375 | 22 | 1,724,693 | 21 | 1,353,414 |
| Maryland | 20 | 1,497,930 | 24 | | 25 | | 26 | |
| West Virginia | 17 | | 21 | 648,882 | 22 | 746,015 | 22 | 501,920 |
| Florida | 8 | 32,905 | 9 | 41,051 | 11 | 64,357 | 10 | 33,965 |
| Georgia | 31 | | 34 | | 40 | | 40 | |
| Mississippi | 6 | 200 | 7 | 351 | 7 | 301 | 6 | 327 |
| North Carolina | 24 | 7,951 | 26 | 11,064 | 27 | 11,033 | 30 | 10,929 |
| South Carolina | 9 | 1,472 | 14 | 1,912 | 12 | 2,086 | 13 | 1,533 |
| Tennessee | 42 | 102,665 | 46 | 142,994 | 53 | 143,542 | 53 | 119,626 |
| Virginia | 41 | | 44 | | 45 | | 44 | |
| Total Southeastern | 264 | 2,865,364 | 294 | 3,789,654 | 324 | 4,494,498 | 325 | 3,417,083 |
| Arkansas | 1 | 987 | 3 | 2,273 | 6 | 4,732 | 5 | 1,797 |
| Oklahoma | 7 | | 8 | | 9 | | 7 | |
| Louisiana | 7 | 366 | 8 | | 8 | | 8 | |
| Texas | 22 | 3,657 | 20 | 4,699 | 22 | 19,171 | 23 | 2,691 |
| Total Southwestern | 37 | 5,010 | 39 | 6,972 | 45 | 23,903 | 43 | 4,488 |
| Illinois | 165 | 1,778,833 | 176 | 2,770,746 | 193 | 3,077,837 | 182 | 1,468,762 |
| Indiana | 97 | 2,408,095 | 109 | 3,473,415 | 116 | 3,661,133 | 120 | 1,891,230 |
| Iowa | 43 | 100,894 | 41 | 62,576 | 51 | 80,893 | 51 | 39,214 |
| Minnesota | 48 | | 48 | 46,024 | 49 | 206,903 | 52 | 131,618 |
| Missouri | 40 | | 48 | 40,367 | 54 | 51,885 | 50 | 25,319 |
| Kansas | 14 | 3,188 | 13 | 3,726 | 17 | 5,108 | 15 | 2,529 |
| Nebraska | 5 | | 8 | | 9 | | 8 | |
| Michigan | 134 | 1,349,916 | 142 | 1,567,890 | 165 | 1,828,870 | 158 | 980,742 |
| Wisconsin | 106 | | 110 | | 118 | | 116 | |
| South Dakota | 1 | 5 | 1 | 9 | | | | |
| Ohio | 232 | 5,234,787 | 258 | 7,013,146 | 278 | 7,173,926 | 276 | 4,274,412 |
| Total North Central | 885 | 10,875,718 | 954 | 14,977,899 | 1,050 | 16,086,555 | 1,028 | 8,813,826 |

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*Consumption of pig iron in the United States, 1935–38, by States and districts*—Con.

| State and district | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Consumers | Gross tons | Consumers | Gross tons | Consumers | Gross tons | Consumers | Gross tons |
| Arizona, Nevada, New Mexico | 3 | 48 | 4 | 72 | 2 | 43 | 1 | 22 |
| Colorado, Utah | 17 | 167,818 | 16 | 320,514 | 15 | 371,688 | 17 | 136,366 |
| Idaho, Wyoming, Montana | 1 | 6,641 | 4 | 2,805 | 5 | 482 | 4 | 196 |
| Total Rocky Mountain | 21 | 174,507 | 24 | 323,391 | 22 | 372,213 | 22 | 136,584 |
| Oregon | 15 | 6,858 | 16 | 8,223 | 18 | 6,810 | 18 | 4,927 |
| Washington | 35 | | 35 | | 41 | | 33 | |
| California | 79 | 101,227 | 90 | 137,266 | 94 | 151,959 | 90 | 88,464 |
| Total Pacific Coast | 129 | 108,085 | 141 | 145,489 | 153 | 158,769 | 141 | 93,391 |
| Total United States | 2,098 | 20,620,463 | 2,265 | 30,098,634 | 2,440 | 34,056,527 | 2,396 | 18,504,349 |

*World production.*—World production of pig iron (including ferro-alloys) in 1938 decreased 20 percent from 1937 and was 4 percent below the 1925–29 average (86,000,000 metric tons). Of the 1938 total the United States supplied 24 percent compared with 36 percent in 1937. Thus, while American production decreased 48 percent, that for the rest of the world decreased only 4 percent.

*Pig iron (including ferro-alloys) produced, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia [2] | 500,000 | 630,000 | 690,000 | 700,000 | 700,000 |
| Belgian Congo | | | | 565 | [2] 600 |
| Belgium | 2,952,520 | 3,029,600 | 3,161,340 | 3,803,750 | 2,464,800 |
| Brazil | 56,924 | 64,082 | 78,418 | 98,108 | [2] 100,000 |
| Canada | 441,916 | 667,028 | 766,625 | 996,671 | 770,594 |
| China | 631,440 | 607,949 | 633,434 | [2] 600,000 | [2] 600,000 |
| Chosen | 210,808 | 245,196 | 216,752 | 168,344 | [2] 200,000 |
| Czechoslovakia | 600,324 | 810,938 | 1,139,886 | 1,675,064 | 1,233,987 |
| Finland | 7,577 | 11,035 | 13,107 | 11,258 | 27,000 |
| France | 6,142,135 | 5,789,780 | 6,230,420 | 7,916,000 | 6,049,000 |
| Germany | 8,716,739 | [3] 12,846,241 | [3] 15,303,179 | [3] 15,959,806 | [4] 18,596,000 |
| Austria | 133,492 | 193,170 | 248,111 | 389,118 | [5] |
| Saar | 1,825,670 | [6] 302,196 | [3] | [3] | [3] |
| Hungary | 140,220 | 185,883 | 206,290 | 357,935 | 335,000 |
| India, British | 1,347,024 | 1,489,216 | 1,568,089 | 1,655,451 | 1,560,000 |
| Italy | 581,455 | 703,833 | 828,484 | 868,946 | 927,604 |
| Japan | 1,772,380 | 1,964,613 | 2,072,445 | [2] 2,500,000 | [2] 3,000,000 |
| Luxemburg | 1,995,193 | 1,872,372 | 1,986,604 | 2,512,495 | 1,550,703 |
| Mexico | 66,458 | 64,139 | 88,032 | 89,717 | [2] 90,000 |
| Netherlands | 257,841 | 253,616 | 274,883 | 311,773 | 266,956 |
| New Zealand | 1,358 | 4,981 | | | |
| Norway | 126,932 | 130,751 | 167,357 | 181,238 | [2] 200,000 |
| Philippine Islands | 150 | [2] 200 | [2] 200 | [2] 200 | [2] 200 |
| Poland | 381,587 | 394,097 | 581,869 | 724,296 | 967,668 |
| Rumania | 61,635 | 81,989 | 97,095 | 127,235 | [2] 130,000 |
| Spain | 372,366 | 354,776 | 280,924 | 193,050 | [2] 200,000 |
| Sweden | 558,129 | 612,596 | 631,736 | 692,865 | 662,500 |
| Union of South Africa | 130,493 | 173,725 | 202,186 | 276,236 | 294,406 |
| U. S. S. R. | 10,495,300 | 12,606,100 | 14,546,077 | 14,520,000 | 15,179,856 |
| United Kingdom | 6,064,802 | 6,527,105 | 7,844,922 | 8,629,313 | 6,871,546 |
| United States | 16,398,077 | 21,715,541 | 31,571,224 | 37,749,575 | 19,474,677 |
| Yugoslavia | 32,620 | 21,793 | 44,453 | 41,006 | 58,458 |
| | 63,004,000 | 74,355,000 | 91,574,000 | 103,750,000 | 82,512,000 |

[1] In addition to countries listed, pig iron is produced in Chile, but production figures are not available.
[2] Approximate production.
[3] Beginning with March 1935 production of the Saar is included with that of Germany.
[4] Includes Austria and the Saar. [5] Production for Austria included with Germany.
[6] Data for January and February only. Beginning with March 1935 production of the Saar is included with Germany.



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## FERRO-ALLOYS

*Production and shipments.*—The production of ferro-alloys was 584,724 gross tons in 1938 compared with 1,008,170 tons in 1937, a decrease of 42 percent. In 1938 ferro-alloys were made at 12 blast-furnace plants, 16 electric-furnace plants, and 3 aluminothermic plants; in addition 3 plants made ferrophosphorus, and 1 plant made ferrosilicon as a byproduct. Of the 1938 total 338,254 tons were made in blast furnaces and 244,161 tons in electric furnaces.

The shipments of all classes of ferro-alloys in 1938 decreased 52 percent in quantity and 51 percent in total value from 1937. Compared with the 5-year average for 1925–29 (715,250 tons), 1938 shipments decreased 35 percent.

*Ferro-alloys shipped from furnaces in the United States, 1937–38, by varieties*

| Variety of alloy | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value |
| Ferromanganese | 359,842 | $30,696,748 | 223,720 | $19,144,884 |
| Spiegeleisen | 134,983 | 3,969,822 | 24,939 | 80,830 |
| Ferrosilicon (7 percent or more silicon) | 362,313 | 17,683,900 | 163,775 | 7,999,661 |
| Ferrophosphorus | 15,546 | 1,059,782 | 6,593 | 469,940 |
| Ferrotungsten | 2,474 | 6,279,913 | 484 | 1,453,227 |
| Other varieties [1] | 95,493 | 26,450,327 | [2] 44,601 | [2] 12,662,971 |
| | 970,651 | 86,140,492 | 464,112 | 41,811,513 |

[1] Ferrochromium, ferrocolumbium, ferromolybdenum and calcium-molybdenum compounds, ferrotitanium, ferrovanadium, ferrozirconium, silicomanganese, silicospiegeleisen, and zirconium ferrosilicon.
[2] Also includes ferroboron.

*Ferromanganese.*—Shipments of ferromanganese in 1938 decreased 38 percent from 1937 and were 26 percent below the 5-year average for 1925–29—303,883 gross tons. The average value per ton, f. o. b. furnaces, reported for ferromanganese was $85.58 in 1938 compared with $85.31 in 1937.

The production of ferromanganese in 1938 decreased 35 percent from 1937 and was made at seven blast-furnace plants and one electric-furnace plant compared with six blast-furnace plants and one electric-furnace plant in 1937. In both years the bulk of the output was made in blast furnaces.

*Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1934–38*

| Year | Ferromanganese produced | | | Materials consumed (gross tons) | | | | Manganese ore used per ton of ferromanganese made (gross tons) |
|---|---|---|---|---|---|---|---|---|
| | Gross tons | Manganese contained | | Manganese ore | | Iron and manganiferous iron ores | Cinder, scale, and purchased scrap | |
| | | Percent | Gross tons | Foreign | Domestic | | | |
| 1934 | 139,171 | 78.67 | 109,491 | 256,980 | 853 | 13,933 | 3,304 | 1.853 |
| 1935 | 214,290 | 79.41 | 170,168 | 401,846 | 4,286 | 9,195 | 8,921 | 1.895 |
| 1936 | 316,000 | 79.09 | 249,933 | 595,114 | 5,987 | 12,467 | 2,821 | 1.902 |
| 1937 | 376,443 | 79.54 | 299,425 | 698,052 | 9,444 | 17,511 | 6,017 | 1.879 |
| 1938 | 242,994 | 78.65 | 191,104 | 416,738 | 22,548 | 9,696 | 8,462 | 1.808 |

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The tonnage of manganese ore used per ton of ferromanganese produced decreased in 1938. Of the total manganese ore used in making ferromanganese in 1938, 5.1 percent was mined in the United States, and 94.9 percent came from foreign sources, as shown in the following table:

*Quantity and tenor of manganese ore used in manufacture of ferromanganese in the United States, 1937–38*

| Source of ore | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Manganese content (percent, natural) | Gross tons | Manganese content (percent, natural) |
| Africa | 150,112 | 48.36 | 152,698 | 48.99 |
| Brazil | 112,238 | 41.43 | 64,060 | 41.44 |
| Chile | 186 | 48.92 | | |
| Cuba | 60,012 | 47.28 | 36,295 | 48.07 |
| India | 62,199 | 50.09 | 55,965 | 49.24 |
| U. S. S. R. | 313,305 | 47.79 | 107,720 | 47.61 |
| United States | 9,444 | 53.17 | 22,548 | 53.20 |
| | 707,496 | 47.13 | 439,286 | 47.72 |

*Spiegeleisen.*—Shipments of spiegeleisen from domestic furnaces in 1938 decreased 82 percent from 1937. The average value per ton at the furnaces was $32.41 in 1938 compared with $29.41 in 1937. The entire production, which also decreased, was made in blast furnaces. Output in 1938 averaged 20.24 percent manganese. Most of the spiegeleisen was made from domestic ores in 1938, only 317 tons of foreign manganese ore being used.

*Ferrosilicon.*—Shipments of ferrosilicon in 1938 decreased 55 percent from 1937.

The production of ferrosilicon in 1938 totaled 249,829 gross tons, including 127,759 tons made by blast furnaces, 121,819 tons by electric furnaces, and 251 tons as a byproduct of the manufacture of artificial abrasives in electric furnaces. The silicon content of the production in 1938 ranged from 7 to 95 percent but averaged 26 percent. Most of the raw material used in making ferrosilicon was of domestic origin.

*Ferrophosphorus.*—Production of ferrophosphorus decreased to 15,842 gross tons containing 24.14 percent phosphorus in 1938 from 21,796 tons containing 21.81 percent phosphorus in 1937, and shipments from furnaces dropped 58 percent. Most of the 1938 output was made in electric furnaces. Ferrophosphorus was made entirely from domestic materials in 1938.

*Ferrotungsten.*—Shipments of ferrotungsten decreased 80 percent in quantity and 77 percent in total value from 1937. The 1938 shipments contained 78.85 percent (854,577 pounds) tungsten and were valued at $1.70 per pound of contained tungsten. Production totaled 442 gross tons containing 78.91 percent tungsten (781,668 pounds). In addition to domestic ores (chiefly from California, Colorado, and Nevada), foreign ores from China, Malay States, and South America were used. All ferrotungsten was made in electric furnaces.

*Foreign trade.*—Imports of all alloys of the rarer metals are not recorded separately but are grouped as shown in the following table. Ferromanganese and spiegeleisen comprised the bulk of the imports in

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1937 and 1938. Imports of ferromanganese for consumption (chiefly from Norway and Netherlands) were 26,258 gross tons—11 percent less than in 1937. Imports of spiegeleisen for consumption (chiefly from Canada) were 17,248 tons, an increase of 2 percent over 1937. The duty on ferrosilicon containing 8 percent but less than 30 percent silicon was cut ½ cent to 1 cent per pound of silicon content, effective January 1, 1939, in the new trade agreement with Canada. That country supplies the bulk of the imports of this material.

*Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1937–38, by varieties*

| Variety of alloy | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Gross weight (gross tons) | Content (gross tons) | Value | Gross weight (gross tons) | Content (gross tons) | Value |
| Ferromanganese: | | | | | | |
| Containing over 1 percent carbon | 28,840 | 23,286 | $2,075,651 | 26,001 | 20,903 | $1,739,501 |
| Containing not over 1 percent carbon | 718 | 603 | 87,965 | 257 | 215 | 31,447 |
| Manganese silicon (manganese content) | (1) | 35 | 2,070 | | | |
| Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content) | (1) | 1 | 733 | (1) | 19 | 8,798 |
| Spiegeleisen | 16,841 | (1) | 589,766 | 17,248 | (1) | 625,480 |
| Ferrochrome or ferrochromium: | | | | | | |
| Containing 3 percent or more of carbon | 164 | 96 | 19,066 | (2) | (2) | 5 |
| Containing less than 3 percent of carbon | 248 | 164 | 44,744 | 175 | 123 | 29,953 |
| Ferrophosphorus | 50 | (1) | 2,679 | | | |
| Ferrosilicon | 12,930 | 2,026 | 349,207 | 5,325 | 626 | 134,067 |
| Chrome or chromium metal | 78 | (1) | 91,014 | 39 | (1) | 48,343 |
| Chromium and zirconium silicon and calcium silicide | 1,685 | (1) | 206,415 | 899 | (1) | 93,317 |
| Ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum (molybdenum content) | (1) | 3 | 13,491 | (1) | (4) | 81 |
| Ferrotitanium | 2 | (1) | 608 | | | |
| Tungsten and combinations, in lumps, grains, or powder: | | | | | | |
| Tungsten metal (tungsten content) | (1) | 59 | 125,569 | (1) | 9 | 23,994 |
| Tungsten carbide (tungsten content) | (1) | 1 | 4,369 | | | |
| Combinations containing tungsten or tungsten carbide (tungsten content) | (1) | (5) | 1,975 | (1) | 1 | 7,523 |
| Tungsten acid and other compounds of tungsten, n. s. p. f. (tungsten content) | (1) | (6) | 1,661 | (1) | (7) | 1,606 |

[1] Not recorded. [2] 100 pounds. [3] 60 pounds. [4] 25 pounds. [5] 379 pounds. [6] 522 pounds. [7] 241 pounds.

*Ferromanganese and ferrosilicon imported for consumption in the United States, 1937–38, by countries*

| Country | Ferromanganese (manganese content) | | | | Ferrosilicon (silicon content) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | | 1938 | | 1937 | | 1938 | |
| | Gross tons | Value | Gross tons | Value | Gross tons | Value | Gross tons | Value |
| Canada | 3,385 | $426,759 | | | 1,532 | $303,391 | 626 | $134,067 |
| Czechoslovakia | 944 | 57,919 | 3,043 | $211,356 | | | | |
| France | 760 | 101,901 | 1,137 | 152,068 | | | | |
| Italy | 43 | 5,706 | | | | | | |
| Japan | 722 | 84,698 | 308 | 37,118 | | | | |
| Netherlands | 282 | 17,033 | 5,843 | 403,561 | | | | |
| Norway | 17,468 | 1,447,177 | 10,547 | 953,045 | 475 | 43,335 | | |
| Poland and Danzig | 156 | 9,897 | | | | | | |
| United Kingdom | 128 | 12,526 | | | 19 | 2,481 | | |
| Yugoslavia | | | 240 | 13,800 | | | | |
| | 23,888 | 2,163,616 | 21,118 | 1,770,948 | 2,026 | 349,207 | 626 | 134,067 |

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Exports of ferro-alloys, which are relatively unimportant from a tonnage standpoint, decreased in 1938 from 1937. Exports of ferromanganese and spiegeleisen in 1938 were 247 gross tons and of other ferro-alloys 1,197 tons.

*Ferro-alloys and ferro-alloy metals exported from the United States, 1937–38, by varieties*

| Variety of alloy | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value |
| Ferromanganese and spiegeleisen | 1,725 | $72,502 | 247 | $18,799 |
| Other ferro-alloys [1] | 2,780 | 2,201,968 | 1,197 | 1,171,869 |

[1] Includes ferrosilicon, ferrotungsten, ferrovanadium, and other ferro-alloys.

## STEEL

*Production.*—Reversing the trend in 1937, when the rate of operation dropped from 81 percent of capacity in January to 25 percent in December, activities in steel production increased during 1938 but did not entirely recover the ground lost during the last quarter of 1937.

The opening of 1938 found operations at a very low level, and during the first half the operating rate was only 31 percent of capacity compared with 85 percent during the first half of 1937. The best month's operation in 1938 was November, when 62 percent of the capacity was employed; during the last quarter of the year the operating rate was about 56 percent of capacity. The following figures covering the output of steel were compiled by the American Iron and Steel Institute. Production of steel ingots and castings in 1938 totaled 28,349,991 gross tons, the lowest since 1934, 43 percent below the 1925–29 average, and a decrease of 44 percent below 1937.

Of the 1938 total, 91.6 percent was made in the open hearth, 6.6 percent in bessemer converters, 1.8 percent in electric furnaces, and only 6 tons in crucible furnaces. The bulk (25,691,963 tons) of the total open-hearth output in 1938 was made in basic furnaces.

Of the total output of steel ingots and castings 28,210,841 gross tons were ingots in 1938 compared with 50,318,151 tons in 1937.

A large part of the steel production comes from the contiguous States—Pennsylvania and Ohio. In 1938 these two States produced about 50 percent of the total steel, 48 percent of the open-hearth steel, and 77 percent of the bessemer steel.

*Open-hearth steel ingots and castings manufactured in the United States, 1934–38, by States, in gross tons*

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

| State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| New England States | 209,527 | 248,778 | 301,161 | 276,021 | 163,658 |
| New York and New Jersey | 1,086,189 | 1,275,496 | 2,109,946 | 2,789,413 | 1,347,802 |
| Pennsylvania | 6,477,890 | 7,850,710 | 12,913,903 | 14,561,700 | 7,072,157 |
| Ohio | 5,649,785 | 7,702,018 | 9,789,985 | 9,067,944 | 5,372,234 |
| Indiana | 3,098,343 | 4,376,998 | 5,963,501 | 5,947,368 | 3,435,360 |
| Illinois | 1,642,437 | 2,534,811 | 3,663,011 | 3,913,318 | 1,950,224 |
| Other States | 5,366,934 | 6,726,618 | 8,794,621 | 9,716,539 | 6,622,865 |
| | 23,531,105 | 30,715,429 | 43,536,128 | 46,272,303 | 25,964,300 |

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*Bessemer-steel ingots and castings manufactured in the United States, 1934–38, by States, in gross tons*

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

| State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Ohio | 1,017,629 | 1,361,933 | 1,639,329 | 1,747,710 | 1,074,032 |
| Pennsylvania | 570,817 | 764,403 | 952,971 | 830,440 | 348,060 |
| Illinois | 299,157 | 375,445 | 866,157 | 871,777 | 458,569 |
| Other States | 274,754 | 333,250 | | | |
| | 2,162,357 | 2,835,031 | 3,458,457 | 3,449,927 | 1,880,661 |

*Steel electrically manufactured in the United States, 1934–38, in gross tons*

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

| Year | Ingots | Castings | Total | Year | Ingots | Castings | Total |
|---|---|---|---|---|---|---|---|
| 1934 | 349,095 | 12,201 | 361,296 | 1937 | 814,310 | 31,227 | 845,537 |
| 1935 | 521,818 | 19,674 | 541,492 | 1938 | 468,610 | 36,414 | 505,024 |
| 1936 | 704,213 | 68,242 | 772,455 | | | | |

The steel-production figure for 1938 includes 1,476,348 gross tons of alloy-steel ingots and castings, which represent 5 percent of the total. The figure includes steels in which the minimum of the range specified in any of the elements named exceeds the following percentages: Nickel, 0.40 percent; chromium, 0.30 percent; copper, 0.50 percent; manganese, 1.65 percent; silicon, 0.50 percent; molybdenum, 0.10 percent; vanadium, tungsten, cobalt, titanium, and zirconium, any percent. Output of alloy steels in 1938 decreased 51 percent from 1937, whereas that of total steel decreased 44 percent. Of the total alloy-steel output in 1938, 71 percent came from basic open hearths, 6 percent from acid open hearths, 23 percent from electric furnaces, 4 tons from crucible furnaces, and 12 tons from bessemer furnaces.

*Production of alloy-steel ingots and castings, 1935–38, by processes, in gross tons*

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

| Process | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| Open hearth, basic | 1,633,541 | 2,239,885 | 2,285,000 | 1,052,706 |
| Open hearth, acid | 73,400 | 115,766 | 146,835 | 91,151 |
| Bessemer | | | | 12 |
| Crucible | 154 | 209 | 241 | 4 |
| Electric | 412,563 | 527,762 | 600,550 | 332,475 |
| | 2,119,658 | 2,883,622 | 3,032,626 | 1,476,348 |

From the foregoing tables it will be seen that the bulk (66 percent in 1938) of the steel made in the electric furnace is alloy steel. Typically, steels with higher alloy content are made in the electric furnace, and steels with lower alloy content are made by the open-hearth process.

*Foreign trade.*—Although exports of iron and steel products (excluding scrap) in 1938 were lower than in 1937 they were higher than in

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any other year since 1929. The volume of export business was off about one-third from the high figure established in 1937, when abnormal demands in foreign markets caused an abrupt rise in shipments. Because of unsettled conditions and expanded armament activities foreign producers were unable to meet demands in their own countries, and buyers turned to the United States for supplies. Shortage of necessary raw materials, inadequate smelting capacity, and finishing and fabricating facilities insufficient to meet expanded demands in other nations caused abnormal exports in a wide range of semimanufactured and manufactured American products. This situation, however, is being rectified by the construction and equipment of new plants and the search for and development of raw material sources. The success of these programs may make other nations more important factors in export markets with a consequent lower demand in this country. Barter methods now being used may make competition difficult for American producers.

Exports of iron ore, pig iron, and ferro-alloys are covered in other items in this report. All important items in the 1938 movement of iron and steel products registered declines. Exports of iron and steel scrap (including tin-plate scrap), though lower than the unprecedented total of 4,101,549 tons in 1937, were high, amounting to 2,998,607 tons. Of the 1938 scrap exports 60 percent went to Japan (46 percent) and Italy (14 percent).

Although exports of American iron and steel products in 1938 reached most of the world's markets Japan was the outstanding purchaser, taking about one-fourth of the total (exclusive of scrap). Canada, United Kingdom, and the Philippines followed Japan in order as the principal takers of American iron and steel in 1938.

*Iron and steel exported from the United States, 1937–38*

| Article | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value |
| Semimanufactures: | | | | |
| Steel ingots, blooms, billets, slabs, and sheet bars | 338,722 | $13,391,372 | 167,641 | $5,905,201 |
| Iron and steel bars and rods: | | | | |
| Iron bars | 2,220 | 191,885 | 1,310 | 100,803 |
| Concrete reinforcement bars | 17,899 | 1,072,617 | 26,105 | 1,366,775 |
| Other steel bars | 139,138 | 10,088,002 | 123,417 | 8,873,068 |
| Wire rods | 60,008 | 3,262,955 | 23,465 | 1,381,414 |
| Iron and steel plates, sheets, skelp, and strips: | | | | |
| Boiler plates | 10,450 | 717,441 | 6,753 | 460,613 |
| Other plates, not fabricated | 376,369 | 20,789,171 | 214,355 | 10,883,283 |
| Skelp iron or steel | 76,478 | 3,506,898 | 59,867 | 2,465,104 |
| Iron and steel sheets, galvanized | 81,019 | 7,470,012 | 76,037 | 7,020,398 |
| Steel sheets, black, ungalvanized | 286,510 | 24,013,717 | 205,278 | 16,442,444 |
| Iron sheets, black | 10,787 | 935,046 | 7,566 | 614,633 |
| Strip band, and scroll iron or steel: | | | | |
| Cold-rolled | 36,323 | 3,850,052 | 25,514 | 2,714,356 |
| Hot-rolled | 74,911 | 4,129,168 | 37,041 | 2,469,958 |
| Tin plate, terneplate, and taggers' tin | 360,683 | 39,939,922 | 161,576 | 19,078,015 |
| Manufactures—steel-mill products: | | | | |
| Structural iron and steel: | | | | |
| Water, oil, gas, and other storage tanks complete and knocked-down material | 44,578 | 3,550,576 | 37,730 | 3,284,095 |
| Structural shapes: | | | | |
| Not fabricated | 135,706 | 6,984,169 | 83,691 | 4,507,428 |
| Fabricated | 39,129 | 3,911,864 | 38,057 | 3,666,049 |
| Plates fabricated, punched, or shaped | 25,221 | 1,507,473 | 2,348 | 219,003 |
| Metal lath | 1,751 | 287,430 | 863 | 160,272 |
| Frames, sashes, and sheet piling | 9,193 | 748,710 | 4,909 | 519,986 |

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*Iron and steel exported from the United States, 1937–38*—Continued

| Article | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value |
| Manufactures—steel-mill products—Continued. | | | | |
| Railway track material: | | | | |
| Rails for railways | 148,182 | $5,166,782 | 82,721 | $3,111,734 |
| Rail joints, splice bars, fishplates, and tieplates | 14,582 | 964,583 | 7,343 | 444,081 |
| Switches, frogs, and crossings | 2,555 | 466,596 | 1,645 | 325,514 |
| Railroad spikes | 3,073 | 218,842 | 2,606 | 186,529 |
| Railroad bolts, nuts, washers, and nut locks | 1,112 | 184,472 | 1,236 | 148,132 |
| Tubular products: | | | | |
| Boiler tubes | 17,458 | 2,784,812 | 8,124 | 1,541,236 |
| Casing and oil-line pipe | 83,481 | 8,302,479 | 63,703 | 6,916,700 |
| Seamless black pipe, other than casing and oil line | 12,482 | 1,507,134 | 7,459 | 1,286,813 |
| Welded black pipe | 25,873 | 2,517,972 | 13,779 | 1,407,519 |
| Welded galvanized pipe | 20,558 | 2,020,902 | 17,404 | 1,762,457 |
| Malleable-iron screwed pipe fittings | 5,385 | 1,596,924 | 3,102 | 1,088,644 |
| Cast-iron screwed pipe fittings | 2,964 | 752,531 | 1,891 | 506,202 |
| Cast-iron pressure pipe and fittings | 20,611 | 1,092,658 | 20,045 | 1,312,048 |
| Cast-iron soil pipe and fittings | 7,601 | 498,395 | 9,957 | 656,704 |
| Riveted-steel or iron pipe and fittings | 980 | 137,421 | 945 | 189,307 |
| Wire and manufactures: | | | | |
| Barbed | 33,834 | 2,592,812 | 33,942 | 2,457,339 |
| Galvanized wire | 22,958 | 1,974,567 | 25,792 | 1,946,316 |
| Iron or steel wire, uncoated | 33,141 | 2,837,389 | 24,080 | 1,830,283 |
| Wire rope, and strand | 7,824 | 1,841,341 | 4,372 | 1,181,125 |
| Woven-wire fencing and screen cloth | 4,749 | 924,247 | 3,541 | 682,452 |
| All other | 9,082 | 2,060,860 | 6,262 | 1,504,675 |
| Nails and bolts (except railroad): | | | | |
| Wire nails | 17,408 | 1,312,961 | 20,720 | 1,369,771 |
| Horseshoe nails | 975 | 208,805 | 888 | 179,128 |
| All other nails, including tacks and staples | 3,508 | 450,984 | 4,348 | 476,580 |
| Bolts, nuts, rivets, and washers (except railroad) | 11,166 | 2,749,617 | 8,057 | 2,082,898 |
| Castings and forgings: | | | | |
| Horseshoes and calks | 179 | 20,802 | 103 | 13,114 |
| Iron and steel, including car wheels and axles | 51,371 | 5,759,688 | 37,634 | 4,536,947 |
| Advanced manufactures: | | | | |
| House heating boilers and radiators | ---------- | 428,957 | ---------- | 333,101 |
| Oil burners and parts | ---------- | 1,305,648 | ---------- | 1,125,993 |
| Tools: | | | | |
| Axes | ---------- | 868,300 | ---------- | 476,610 |
| Shovels and spades | ---------- | 276,232 | ---------- | 248,392 |
| Hammers and hatchets | ---------- | 372,383 | ---------- | 232,008 |
| Saws, wood and metal cutting | ---------- | 1,746,366 | ---------- | 1,225,686 |
| All other tools | ---------- | 12,109,554 | ---------- | 9,356,596 |

Imports for consumption of iron and steel (exclusive of scrap) in 1938 were the lowest since 1921 and amounted to about half of the 1937 volume. The import trade was much lower than the export trade. Declines were recorded throughout the list, and while ferromanganese and spiegeleisen held up fairly well pig iron dropped sharply. Structural shapes, pipes, and bars were imported in largest quantities among the manufactured and unmanufactured articles in 1938, but all were received in much smaller quantities than in 1937. Imports came principally from European countries, Canada, and British India. Imports of scrap in 1938 amounted to only 24,451 long tons (70 percent below 1937), and 97 percent of the 1938 total came from Canada.

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*Iron and steel imported for consumption in the United States, 1937–38, by commodities*

| Commodity | 1937 | | 1938 | |
|---|---|---|---|---|
| | Gross tons | Value | Gross tons | Value |
| Semimanufactures: | | | | |
| Steel bars: | | | | |
| Concrete reinforcement | 3,894 | $114,082 | 1,531 | $51,924 |
| Solid or hollow, n. e. s | 44,191 | 2,268,840 | 18,899 | 1,122,228 |
| Hollow and hollow drill steel | 2,537 | 357,491 | 865 | 131,386 |
| Iron slabs, blooms, or other forms | 1 | 33 | (1) | 5 |
| Bar iron | 1,956 | 141,661 | 504 | 29,005 |
| Wire rods, nail rods, and flat rods up to 6 inches in width | 15,819 | 1,361,466 | 5,280 | 410,454 |
| Boiler or other plate iron or steel, except crucibles and saw-plate steel | 204 | 8,105 | 355 | 18,900 |
| Sheets or plates of iron or steel | 9 | 2,034 | (1) | 17 |
| Steel ingots, blooms, and slabs | 130 | 4,612 | 205 | 5,586 |
| Billets, solid or hollow | 2,077 | 223,268 | 553 | 65,413 |
| Die blocks or blanks; shafting, etc | 102 | 38,630 | 96 | 34,191 |
| Circular saw plates | 27 | 11,624 | 32 | 14,233 |
| Sheets of iron or steel, common or black and boiler or other plate iron or steel | 6,766 | 274,481 | 5,651 | 290,289 |
| Sheets and plates and steel, n. s. p. f | 2,007 | 97,211 | 361 | 29,634 |
| Tin plate, terneplate, and taggers' tin | 246 | 71,764 | 109 | 32,013 |
| Manufactures: | | | | |
| Structural iron and steel | 78,273 | 2,597,657 | 39,624 | 1,494,869 |
| Rails for railways | 7,891 | 219,109 | 3,336 | 98,020 |
| Rail braces, bars, fishplates or splice bars and tie plates | 407 | 20,639 | 288 | 14,935 |
| Pipes and tubes: | | | | |
| Cast-iron pipe and fittings | 3,698 | 209,886 | 1,619 | 59,420 |
| Other pipes and tubes | 42,486 | 3,955,212 | 29,102 | 2,481,334 |
| Wire: | | | | |
| Barbed | 16,666 | 867,809 | 12,528 | 720,378 |
| Round iron and steel | 4,612 | 839,725 | 1,531 | 308,223 |
| Balling | 254 | 13,342 | 152 | 10,170 |
| Telegraph, telephone, etc., except copper, covered with cotton jute, etc | 34 | 10,384 | 27 | 14,144 |
| Flat and steel strips not thicker than ¼-inch and not over 16 inches wide | 4,033 | 2,136,754 | 2,696 | 1,616,961 |
| Rope and strand | 3,548 | 549,393 | 2,020 | 376,406 |
| Galvanized fencing wire and wire fencing | 3,250 | 161,834 | 1,459 | 96,865 |
| Hoop or band iron or steel for baling | 1,611 | 76,727 | 9,403 | 406,246 |
| Hoop, band, strips, or scroll iron or steel, n. s. p. f | 25,618 | 896,377 | 16,728 | 644,974 |
| Nails | 15,032 | 1,086,633 | 7,598 | 649,898 |
| Castings and forgings, n. e. s | 4,586 | 591,721 | 3,815 | 427,788 |

[1] Less than 1 ton.

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# MANGANESE AND MANGANIFEROUS ORES

By Robert H. Ridgway and H. W. Davis [1]

## SUMMARY OUTLINE


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Demand for manganese ore was less in 1938 than in 1937 owing to a recession in the rate of world steel production, and imports into all large consuming countries decreased. High stocks on hand in some consuming countries, notably the United States, at the beginning of the year and curtailed activities in consuming outlets, materially reduced the volume of business. In consequence, prices slumped heavily as the year progressed.

Despite the sharp drop in imports in 1938 (47 percent below 1937), stocks of ore in bonded warehouses increased sharply and established a new year-end peak. As most of the domestic requirement is supplied by imports, the apparent consumption of manganese ore reflected the drop in imports for consumption. Although the small domestic production decreased, it was stimulated by Navy purchases of ferromanganese which required that the ferro-alloy be made from domestic ores. Two furnaces, one at Reusens, Va., and the other at Minnequa, Colo., supplied the total (largely from Montana ore). The higher rate of steel activity in the Birmingham district compared with other producing centers benefited producers of manganese ore in the Southeastern States.

*Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1934–38, in long tons*

| | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Manganese ore: | | | | | | |
| Total shipments containing 35 percent or more Mn | 59,312 | 26,514 | 26,428 | 32,119 | 40,241 | 25,321 |
| Shipments of metallurgical ore | [1] 41,892 | 14,978 | 16,679 | 18,557 | 26,419 | 16,989 |
| Shipments of battery ore | 17,420 | 8,889 | 7,264 | 7,747 | 6,447 | 4,959 |
| Imports for consumption | 600,000 | 341,338 | 383,500 | 813,362 | 911,919 | 483,588 |
| Stocks in bonded warehouses at end of year | 304,000 | 430,714 | 418,302 | 366,381 | 681,290 | 842,048 |
| Indicated consumption (35 percent or more Mn) | 659,000 | 369,563 | 413,286 | 848,491 | 954,503 | 509,932 |
| Ferro-alloys: | | | | | | |
| Production of ferromanganese | 306,360 | 139,171 | 214,290 | 316,000 | 376,443 | 242,994 |
| Imports of ferromanganese [2 3] | [4] 50,590 | 18,702 | 21,830 | 30,593 | 23,888 | 21,118 |
| Production of spiegeleisen | 95,463 | [5] | 60,018 | 95,137 | [5] | 11,311 |
| Imports of spiegeleisen [2] | 7,298 | 21,184 | 32,384 | 52,011 | 16,841 | 17,248 |
| Exports of spiegeleisen and ferromanganese | 3,769 | 222 | 131 | 466 | 1,725 | 247 |
| Stocks of ferromanganese in bonded warehouses | [3 4] 7,765 | 7,124 | 5,796 | 9,902 | 11,788 | 8,392 |

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.
[5] Bureau of Mines not at liberty to publish figures.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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The Bureau of Mines continued experimental work on the process for the production of pure electrolytic manganese.[2] A license to use the procedure was issued in 1938,[3] and a small pilot plant was under construction at Knoxville, Tenn.

The trend of imports and domestic production of manganese ore is shown graphically in figure 1.

*Strategic reserve.*—In connection with its purchases of certain strategic commodities, the Navy Department issued specifications and called for bids on manganese ore with alternate bids on low-grade

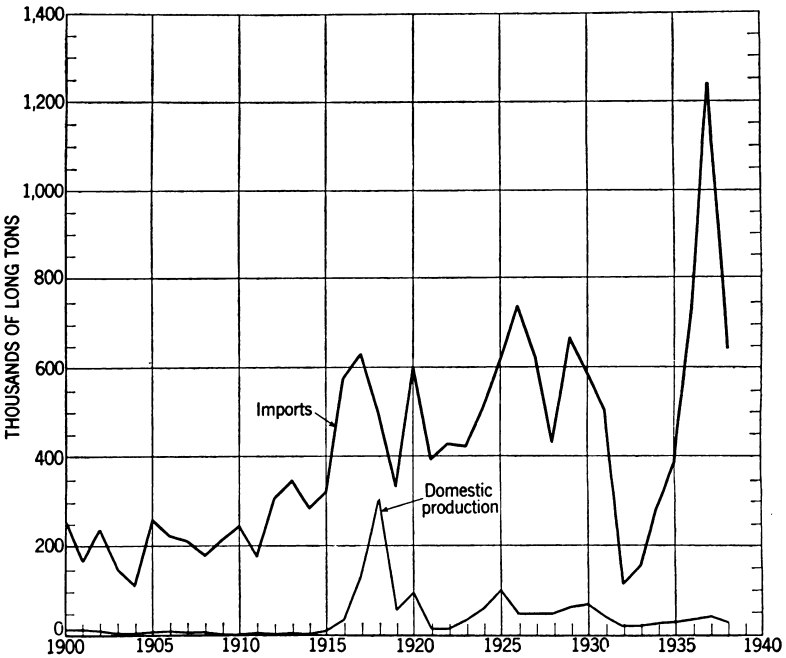


FIGURE 1.—Imports and domestic production of manganese ore, 1900–1938. Statistics on imports shown in the graph represent "general imports" for the period 1900–1933; beginning with 1934 data classified as "general imports" were not available, and the figures plotted for 1934–38 represent imports for consumption adjusted for changes in stocks in bonded warehouses and are closely comparable with the record for earlier years.

ferromanganese, on October 29, 1937. All were rejected, however, because the material specified was not considered satisfactory, and the specifications were reconsidered. Later (March 18, 1938) bids on standard-grade ferromanganese were called for. Early in April two contracts were let—one to E. J. Lavino & Co. for 6,000 long tons at $110.50 per long ton at the Philadelphia Navy Yard and the other to the Colorado Fuel & Iron Corporation for 5,500 long tons at $105 per long ton f. o. b. plant at Minnequa, Colo. The contracts were completed during the year.

These purchases were made from a limited appropriation of the Navy Department for stockpiles of strategic commodities. Legisla-

[2] Shelton, S. M., Royer, M. B., and Towne, A. P., Electrolytic Manganese. Progress Report 23—Metallurgical Division: Bureau of Mines Rept. of Investigations 3406, 1938, pp. 3–16.
Dean, R. S., and others, Annual Report of the Metallurgical Division, Fiscal Year 1937–38. Progress Report 25—Metallurgical Division: Bureau of Mines Rept. of Investigations 3419, 1938, pp. 13–20.

[3] Shelton, S. M., Electrolytic Process for the Extraction of Metallic Manganese: United States Patent 2,119,560, June 7, 1938.

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tion providing the purchase of much larger quantities has been given serious consideration in the past few years, and bills passed both houses of Congress early in 1939. The following tables present data that may be of interest in studying the strategic position of manganese ore.

*Domestic shipments of manganese ore, imports of manganese and ferromanganese, and apparent consumption of manganese metal, 1910–38, in long tons*

| Year | Manganese ore | | | Imports of ferro-manganese (gross weight) | Apparent consumption of manganese metal [1] | |
|---|---|---|---|---|---|---|
| | Domestic shipments | | Imports | | Quantity | Percent from domestic sources |
| | 10 to 35 percent Mn | 35 percent or more Mn | | | | |
| 1910 | (2) | 2,258 | 242,348 | 114,228 | (3) | ---------- |
| 1911 | [4] 2,602 | 2,457 | 176,852 | 80,263 | (3) | ---------- |
| 1912 | [4] 2,782 | 1,664 | 300,661 | 99,137 | (3) | ---------- |
| 1913 | [4] 9,650 | 4,048 | 345,090 | 128,070 | 217,658 | 4.1 |
| 1914 | [4] 60,484 | 2,635 | 283,294 | 82,997 | 162,112 | 7.5 |
| 1915 | [4] 64,204 | [4] 9,558 | 320,778 | 55,263 | 179,266 | 13.2 |
| 1916 | [4] 316,600 | 31,474 | 576,321 | 90,928 | 283,944 | 15.6 |
| 1917 | [4] 576,608 | [4] 129,351 | 629,972 | 41,969 | 271,770 | 22.7 |
| 1918 | [4] 818,003 | 305,869 | 491,303 | 27,168 | 297,303 | 35.2 |
| 1919 | [4] 211,632 | [4] 54,957 | 333,344 | 33,022 | 162,378 | 31.7 |
| 1920 | [4] 357,279 | 94,420 | 599,764 | 59,254 | 278,952 | 16.5 |
| 1921 | [4] 8,439 | 13,531 | 392,606 | 9,077 | 96,104 | 16.0 |
| 1922 | [4] 344,674 | [4] 13,404 | 425,000 | [5] 100,725 | 211,714 | 6.3 |
| 1923 | [4] 319,666 | [4] 31,500 | 419,000 | [5] 113,833 | 309,254 | 9.7 |
| 1924 | [4] 286,470 | [4] 56,515 | 505,000 | [5] 56,588 | 230,264 | 9.9 |
| 1925 | [4] 267,252 | 98,324 | 615,000 | [5] 78,713 | 280,725 | 8.6 |
| 1926 | [4] 364,312 | 46,258 | 738,000 | [5] 59,710 | 316,308 | 8.0 |
| 1927 | [4] 148,291 | 44,741 | 622,067 | [5] 45,500 | 291,206 | 9.4 |
| 1928 | [4] 90,581 | 46,860 | 427,708 | [5] 60,055 | 320,496 | 10.4 |
| 1929 | 78,191 | 60,379 | 664,269 | [5] 71,211 | 356,079 | 9.3 |
| 1930 | 77,417 | 67,035 | 585,568 | [5] 55,046 | 280,130 | 9.2 |
| 1931 | 64,062 | 39,242 | 502,518 | 24,664 | 166,492 | (6) |
| 1932 | 15,635 | 17,777 | 110,634 | 18,470 | 67,673 | 14.4 |
| 1933 | 12,779 | 19,146 | 156,836 | 39,693 | 150,379 | 3.4 |
| 1934 | 23,231 | 26,514 | 341,339 | 23,349 | (6) | (6) |
| 1935 | 93,291 | 26,428 | 383,500 | 27,240 | 210,784 | 4.8 |
| 1936 | 98,962 | 32,119 | 813,362 | 37,953 | 310,497 | 4.1 |
| 1937 | 151,955 | 40,241 | 911,922 | 29,559 | (6) | (6) |
| 1938 | 33,620 | 25,321 | 483,588 | 26,258 | 217,961 | 6.1 |

[1] In ferromanganese and spiegeleisen.
[2] Fluxing ore only.
[3] Data not available.
[4] Exclusive of fluxing ore.
[5] Manganese content reported from Sept. 22, 1922, through 1930; gross weight calculated.
[6] Bureau of Mines not at liberty to publish figures.

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*Manganese ore (35 percent or more Mn) produced and shipped in the United States, 1910–38, by States, in long tons*

| Year | Alabama | Arizona | Arkansas | California | Colorado | Georgia | Idaho | Montana | Nevada |
|---|---|---|---|---|---|---|---|---|---|
| 1910 | | | 500 | | | | | | |
| 1911 | | | | 2 | | | | | |
| 1912 | | | | 19 | | | | | |
| 1913 | | | | | | | | | |
| 1914 | | | | 501 | | | | | |
| 1915 | 200 | 339 | 1,288 | 2,563 | 150 | 3,168 | | | |
| 1916 | 27 | 3,060 | 6,318 | 6,136 | 110 | 1,572 | | 6,418 | 309 |
| 1917 | 264 | 14,802 | 10,140 | 14,196 | [1] 60 | 3,614 | | 61,109 | 3,450 |
| 1918 | 709 | 17,612 | 7,731 | 24,067 | 4,821 | 6,679 | | 199,932 | 19,872 |
| 1919 | 40 | [1] 529 | 2,558 | 11,289 | 11,166 | 48 | | 24,993 | [1] 78 |
| 1920 | 57 | 2,402 | 3,445 | 1,733 | 3,643 | 341 | | 76,441 | 1,240 |
| 1921 | | 328 | 728 | | 490 | | | 11,129 | |
| 1922 | | 203 | 2,264 | 255 | | | | [1] 9,751 | 18 |
| 1923 | 24 | 245 | 3,768 | 355 | 2,278 | 1,502 | | [1] 21,916 | |
| 1924 | 1,242 | 42 | 3,400 | 850 | 5,338 | 1,093 | | [1] 35,445 | 1,310 |
| 1925 | 938 | 294 | 3,517 | 869 | 743 | 1,649 | | 76,188 | 850 |
| 1926 | 896 | 2,684 | 2,450 | 393 | | 3,251 | 830 | 23,617 | 1,607 |
| 1927 | 687 | 3,905 | 2,605 | | 84 | 489 | 3,181 | 26,506 | 1,357 |
| 1928 | 421 | 3,507 | 3,623 | | | 4,727 | 1,345 | 26,733 | |
| 1929 | | 2,655 | 4,308 | 569 | | 2,521 | 1,326 | 42,327 | |
| 1930 | | 364 | 3,276 | 162 | | 18,897 | | 35,605 | 1,489 |
| 1931 | | 40 | 4,028 | 40 | | 6,491 | | 25,812 | |
| 1932 | 267 | | 1,306 | | | 200 | | 15,479 | |
| 1933 | 806 | | 1,890 | | | 1,565 | | 9,320 | |
| 1934 | | | 5,842 | 158 | | 6,281 | | 11,548 | |
| 1935 | 185 | | 3,809 | 306 | | 6,960 | | 10,823 | |
| 1936 | 572 | | 4,557 | | | 3,821 | | 16,456 | |
| 1937 | 289 | | 3,931 | | | 689 | | 26,744 | |
| 1938 | 202 | | 2,987 | | | 3,058 | | 11,936 | 43 |

| Year | New Mexico | Tennessee | Texas | Utah | Virginia | Washington | Other States [2] | United States |
|---|---|---|---|---|---|---|---|---|
| 1910 | | | | | 1,758 | | | 2,258 |
| 1911 | | | | | 2,455 | | | 2,457 |
| 1912 | | | | | 1,537 | | 108 | 1,664 |
| 1913 | | | | | 4,048 | | | 4,048 |
| 1914 | | | | | 1,724 | | 410 | 2,635 |
| 1915 | | 150 | 50 | [1] 30 | 1,620 | | | [1] 9,558 |
| 1916 | 506 | 429 | 800 | 1,282 | 4,417 | 90 | | 31,474 |
| 1917 | 2,603 | 1,996 | 25 | 4,195 | 12,360 | | 537 | [1] 129,351 |
| 1918 | 3,126 | 4,162 | 380 | 5,100 | 10,928 | | 750 | 305,869 |
| 1919 | | 328 | | | 3,928 | | | [1] 54,957 |
| 1920 | 2,053 | 502 | | | 2,523 | | 40 | 94,420 |
| 1921 | | 139 | | | 717 | | | 13,531 |
| 1922 | | 113 | | | 800 | | | [1] 13,404 |
| 1923 | 179 | 213 | | | 987 | | 33 | [1] 31,500 |
| 1924 | 775 | 455 | | | 1,565 | 5,000 | | [1] 56,515 |
| 1925 | 1,588 | 352 | | 50 | 3,121 | 8,113 | 52 | 98,324 |
| 1926 | 1,966 | 1,555 | | | 3,792 | 3,162 | 55 | 46,258 |
| 1927 | 2,190 | 498 | | 27 | 3,212 | | | 44,741 |
| 1928 | 2,627 | 55 | | | 3,812 | | 10 | 46,860 |
| 1929 | 2,969 | 523 | 42 | 88 | 3,051 | | | 60,379 |
| 1930 | 2,574 | 508 | 247 | | 3,853 | | 60 | 67,035 |
| 1931 | 1,072 | 70 | 155 | | 1,505 | | 29 | 39,242 |
| 1932 | | | | | 525 | | | 17,777 |
| 1933 | | 588 | | | 4,882 | | 95 | 19,146 |
| 1934 | | 1,088 | | | 1,597 | | | 26,514 |
| 1935 | | 1,893 | | | 2,452 | | | 26,428 |
| 1936 | | 3,539 | | 1,635 | 1,361 | | 178 | 32,119 |
| 1937 | 878 | 3,575 | 38 | 32 | 2,265 | | 1,800 | 40,241 |
| 1938 | 560 | 4,130 | | | 2,242 | | 163 | 25,321 |

[1] Exclusive of fluxing ore.
[2] Massachusetts, New Jersey, North Carolina, Oklahoma, Oregon, South Carolina, South Dakota, West Virginia, and Wyoming.

## DOMESTIC PRODUCTION

The domestic production (shipments from domestic mines) of manganese ore decreased 37 percent in 1938 from 1937. Of the manganese ore shipped to metallurgical plants in 1938, 5,356 long tons contained (natural) 48 percent or more Mn.

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*Manganiferous raw materials shipped by producers in the United States, 1934–38, in long tons*

| Year | Metallurgical ore (ferrous metallurgy only) | | | | Battery ore | Miscellaneous manganese ore |
|---|---|---|---|---|---|---|
| | Manganese ore (35 percent or more Mn) | Ferruginous manganese ore (10 to 35 percent Mn) | Manganiferous iron ore (5 to 10 percent Mn) | Manganiferous zinc residuum | | |
| 1934 | 14,978 | 23,231 | 198,591 | 65,236 | 8,889 | 2,647 |
| 1935 | 16,679 | 93,291 | 430,893 | 113,997 | 7,264 | 2,485 |
| 1936 | 18,557 | 98,962 | 841,557 | 124,288 | 7,747 | 5,815 |
| 1937 | 26,419 | 151,955 | 1,189,017 | 115,998 | 6,447 | 7,375 |
| 1938 | 16,989 | 33,620 | 275,240 | 39,079 | 4,959 | 3,373 |

Shipments of the various grades during the last 5 years are given, by States, in the following tables. In addition, battery-grade ores were produced in Montana; manganiferous zinc residuum was produced from New Jersey zinc ores; and miscellaneous manganese ores came from Alabama, Montana, Nevada, Tennessee, Virginia, and West Virginia.

*Metallurgical manganese ore shipped from mines in the United States, 1934–38, by States, in long tons*

| State | 1934 | 1935 | 1936 | 1937 | 1938 | State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | ------ | 59 | 377 | 31 | 111 | Texas | ------ | ------ | ------ | 38 | ------ |
| Arkansas | 5,842 | 3,809 | 4,557 | 3,931 | 2,987 | Utah | ------ | ------ | 1,635 | 32 | ------ |
| California | 158 | 306 | ------ | ------ | ------ | Virginia | 1,040 | 1,972 | 196 | 952 | 1,314 |
| Georgia | 6,281 | 6,960 | 3,821 | 689 | 3,058 | West Virginia | ------ | ------ | 138 | 1,800 | 56 |
| Montana | 1,657 | 2,155 | 5,154 | 16,854 | 5,300 | | | | | | |
| New Mexico | ------ | ------ | ------ | 878 | 560 | | 14,978 | 16,679 | 18,557 | 26,419 | 16,989 |
| Tennessee | ------ | 1,418 | 2,679 | 1,214 | 3,603 | | | | | | |

*Ferruginous manganese ore shipped from mines in the United States, 1934–38, by States, in long tons*

| State | 1934 | 1935 | 1936 | 1937 | 1938 | State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 1,404 | 647 | 540 | 279 | 356 | Nevada | ------ | ------ | ------ | 533 | ------ |
| Arkansas | 1,374 | 145 | 3,285 | 7,509 | 3,477 | New Mexico | ------ | ------ | 170 | 18,581 | 6,093 |
| Colorado | ------ | 2,625 | 10,568 | 11,577 | 655 | Tennessee | ------ | ------ | 104 | 902 | 456 |
| Georgia | 9,166 | 3,735 | 2,717 | 4,045 | 2,807 | Utah | ------ | 190 | 2,974 | 3,436 | ------ |
| Massachusetts | ------ | ------ | ------ | ------ | 230 | Virginia | 40 | 645 | 874 | 1,170 | 1,670 |
| Michigan | ------ | 555 | 9,627 | ------ | ------ | | | | | | |
| Minnesota | ------ | 77,931 | 47,796 | 84,263 | 17,424 | | 23,231 | 93,291 | 98,962 | 151,955 | 33,620 |
| Montana | 11,247 | 6,818 | 20,307 | 19,660 | 452 | | | | | | |

*Manganiferous iron ore shipped from mines in the United States, 1934–38, by States, in long tons*

| State | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Alabama | ------ | ------ | ------ | 149 | ------ |
| Colorado | ------ | 56 | ------ | ------ | ------ |
| Georgia | 31 | ------ | 427 | 5,492 | ------ |
| Michigan | 595 | 4,847 | ------ | 9,739 | 16,057 |
| Minnesota | 197,622 | 419,373 | 840,725 | 1,173,637 | 259,183 |
| Wisconsin | 343 | 6,617 | 405 | ------ | ------ |
| | 198,591 | 430,893 | 841,557 | 1,189,017 | 275,240 |

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Further details for 1938, by States, are given in the following table.

*Manganese and manganiferous ores shipped by mines in the United States in 1938, by States*

| | Ore containing 35 percent or more Mn | | | Ore containing 10 to 35 percent Mn | | | Ore containing 5 to 10 percent Mn | | |
|---|---|---|---|---|---|---|---|---|---|
| | Shippers | Long tons | Value | Shippers | Long tons | Value | Shippers | Long tons | Value |
| Metallurgical: | | | | | | | | | |
| Alabama | [1] 1 | 111 | $1,324 | 3 | 356 | $2,797 | | | |
| Arkansas | 2 | 2,987 | [2] | 2 | 3,477 | [2] | | | |
| Colorado | | | | 2 | 655 | [2] | | | |
| Georgia | 5 | 3,058 | 46,443 | 7 | 2,807 | 12,057 | | | |
| Massachusetts | | | | 1 | 230 | [2] | | | |
| Michigan | | | | | | | 1 | 16,057 | $700,776 |
| Minnesota | | | | 2 | 17,424 | [2] | 3 | 259,183 | |
| Montana | [1] 1 | 5,300 | [2] | 2 | 452 | 1,971 | | | |
| New Mexico | 1 | 560 | [2] | 2 | 6,093 | [2] | | | |
| Tennessee | [1] 3 | 3,603 | 60,829 | 3 | 456 | 3,228 | | | |
| Virginia | [1] 8 | 1,314 | 21,588 | 7 | 1,670 | 15,502 | | | |
| West Virginia | [1] 1 | 56 | 966 | | | | | | |
| Undistributed | | | 247,366 | | | 122,025 | | | |
| Total metallurgical | 22 | 16,989 | 378,516 | 31 | 33,620 | 157,580 | 4 | 275,240 | 700,776 |
| Battery: Montana | [1] [3] 2 | 4,959 | 234,436 | | | | | | |
| Miscellaneous: | | | | | | | | | |
| Alabama | [1] 1 | 91 | 1,706 | | | | | | |
| Montana | [1] 3 | 1,677 | 31,897 | | | | | | |
| Nevada | 1 | 43 | 416 | | | | | | |
| Tennessee | [1] 3 | 527 | 16,977 | | | | | | |
| Virginia | [1] 10 | 928 | 16,227 | | | | | | |
| West Virginia | [1] 1 | 107 | 1,504 | | | | | | |
| Total miscellaneous | 19 | 3,373 | 68,727 | | | | | | |
| | 32 | 25,321 | 681,679 | 31 | 33,620 | 157,580 | 4 | 275,240 | 700,776 |

[1] 1 producer in Alabama, 1 in Montana, 2 in Tennessee, 5 in Virginia, and 1 in West Virginia shipped both metallurgical and miscellaneous ore, and 1 in Montana shipped both battery and miscellaneous ore.
[2] Included under "Undistributed."
[3] Mills through which all ore was shipped; producers not counted.

*Alabama.*—All shipments of manganese ore from Alabama in 1938 were made by J. B. Bynum, who operates the Walnut Grove mine at Walnut Grove, Etowah County. The ore shipped to metallurgical plants (111 long tons) averaged (natural) 36.33 percent Mn, while that shipped for miscellaneous uses ran (natural) 74.01 percent $MnO_2$. Shipments of ferruginous manganese ore came from Calhoun and Etowah Counties and averaged (natural) 27.53 percent Mn. No manganiferous iron ore was shipped in 1938.

*Arizona.*—Although no production was recorded in Arizona in 1938, exploration work in the area near Artillery Peak, Mohave County, was continued during the year.

*Arkansas.*—Two shippers, Walter H. Denison and A. B. Reither, supplied the Arkansas total (2,987 long tons) of manganese ore in 1938 from operations in the Batesville-Cushman district in Independence County. The ore averaged (natural) 45.10 percent Mn. In addition, they shipped the entire output of ferruginous manganese ore (3,477 tons). The ferruginous manganese ore averaged (natural) 22.98 percent Mn.

*Colorado.*—No manganese ore was shipped from Colorado in 1938, but 655 long tons of ferruginous manganese ore were shipped from two operations. The bulk of the total came from the King-United mine in San Juan County and contained (natural) 32.5 percent Mn and 20.2

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percent iron. This property is reported to have closed in October. The remainder came from the Pershing mine in Saguache County and contained (natural) 21.6 percent Mn and 9.2 percent iron.

*Georgia.*—Aside from 1 small carload from McDuffie County near Littleton, which contained (natural) 41.41 percent Mn, all manganese ore from Georgia in 1938 came from four shippers in the Cartersville district in Bartow County, of which the White Manganese Corporation supplied the larger part. The manganese ore from Georgia averaged (natural) 38.91 percent Mn and was shipped to Birmingham, Ala. The Cartersville district likewise supplied the bulk (2,738 long tons) of the Georgia shipments of ferruginous manganese ore which averaged (natural) 16.85 percent Mn. Shipments of 69 tons of ore, which ran (natural) 22.83 percent Mn, were also reported from the Gibson mine in Floyd County. No manganiferous iron ore was shipped from Georgia in 1938, but shipments of untreated iron ore which contained up to 5 percent Mn were continued during 1938. This ore is mined cheaply from small open-cuts and shipped by rail to Birmingham.

*Massachusetts.*—Shipments of ferruginous manganese ore from Massachusetts in 1938, the first in several years, totaled 230 long tons containing (natural) 27 percent Mn and 3 percent iron. The ore came from the Taconic mine in Hampshire County.

*Michigan.*—The Eureka mine in Iron County supplied the manganiferous iron ore shipped from Michigan in 1938. The ore averaged (natural) 5.61 percent Mn and 47.25 percent iron.

*Minnesota.*—All shipments of manganese-bearing ores from Minnesota in 1938 came from the Cuyuna range in Crow Wing County. Of the ferruginous manganese ore shipped in 1938, 16,698 long tons containing (natural) 17.40 percent Mn and 31.67 percent iron came from the Merritt mine, while 726 tons containing (natural) 16.86 percent Mn and 28.39 percent iron came from the Mangan mine. Five properties—the Alstead-Hillcrest, the Hopkins, the Louise, the Sagamore, and the Mahnomen—supplied the shipments of manganiferous iron ore from Minnesota in 1938. The ore averaged (natural) 7.52 percent Mn and 35.84 percent iron.

*Montana.*—Shipments of manganese ore from Montana in 1938 decreased 55 percent from 1937. Of the total, 44 percent was nodulized rhodochrosite from the Emma mine at Butte, which averaged (dried) 59.25 percent Mn, while 42 percent was battery-grade concentrates from the Philipsburg district, which averaged (natural) about 70 percent $MnO_2$. Ores for miscellaneous uses were shipped from both districts. Shipments of ferruginous manganese ore consisted of 133 tons of rhodochrosite from the Emma mine containing (natural) 33.06 percent Mn and 319 tons of tailings containing (dried) 21 percent Mn from the Trout mill. The new mill at the Trout mine was completed and put into operation in 1938.

*Nevada.*—One carload of ore containing (natural) 38.75 percent Mn was shipped from Nevada in 1938.

*New Mexico.*—Shipments of manganese ore from New Mexico in 1938 came from the Luna Manganese Co. in Luna County and contained (natural) 45 percent Mn and 4 percent iron. Shipments of ferruginous manganese ore comprised 5,113 long tons containing (natural) 12.7 percent Mn and 41.2 percent iron from the Boston Hill mine near Silver City in Grant County and 980 tons containing

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(natural) 31.4 percent Mn and 8.8 percent iron from the Lake Valley mine in Sierra County.

*Tennessee.*—Operations in four counties—Carter, Johnson, Monroe, and Unicoi—supplied the total output of Tennessee in 1938, which comprised 3,603 long tons averaging (natural) 35.47 percent Mn shipped to metallurgical plants and 527 tons averaging (natural) 42.31 percent Mn shipped to chemical plants. The largest production came from the Embree Iron Co. in Unicoi County near Embreeville, where additional milling capacity was installed during the year. Most of the remainder was supplied by R. U. Butler from the Cedar Hill mine in Carter County. One small carload came from Monroe County near Sweetwater. Shipments of ferruginous manganese ore, which averaged (natural) 15.13 percent Mn, came principally from Johnson County.

*Utah.*—No manganese-bearing ores were shipped from Utah in 1938. The manganese deposits in the Drum Mountains, from which over 15,000 tons have been shipped in the past, have been described by Callaghan.[4]

*Virginia.*—Shipments of manganese ore from Virginia in 1938 decreased slightly compared with 1937 and comprised 928 tons of miscellaneous ore containing (natural) 41.92 percent Mn and 1,314 tons of metallurgical ore containing 40.94 percent Mn. The manganese ore originated in Appomattox, Bland, Campbell, Page, Shenandoah, and Smyth Counties. Shipments of ferruginous manganese ore in 1938 came from Allegheny, Augusta, Bland, Page, and Smyth Counties and averaged (natural) 24.85 percent Mn.

*West Virginia.*—The entire output of West Virginia in 1938 came from the Sweet Springs mine near Sweet Springs, Monroe County. This property, formerly operated by the Monroe Manganese Corporation, was worked in 1938 by the Appalachian Ores Co., which shipped 107 tons of miscellaneous ore averaging (dried) 40 percent Mn and 1 car to a metallurgical consumer containing (natural) 48 percent Mn and 2 percent iron.

*Puerto Rico.*—The entire output of Puerto Rico comes from the mine of the Atlantic Ore Co. about 3 miles from Juana Diaz and is shipped to the United States. Shipments in 1938 were 1,023 long tons containing 50 percent Mn.

## IMPORTS OF MANGANESE ORE

Imports of manganese ore in 1938 decreased 47 percent from the record total of 1937. Receipts declined from all principal sources, except Cuba, the second largest source in 1938. The U. S. S. R. was the largest source and supplied 34 percent of the total. In addition to the 1938 imports shown in the following table, 30,051 tons of ore containing 8,689 tons of manganese (29 percent Mn) valued at $127,430 were imported from the Union of South Africa.

[4] Callaghan, E., Manganese Deposits of the Drum Mountains: Econ. Geol., vol. 33, No. 5, August 1938, p. 508.

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*Manganese ore (35 percent or more Mn) imported for consumption in the United States, 1936–38, by countries*

| Country | Manganese ore (long tons) | | | Mn content (long tons) | | | Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 |
| Brazil | 110,018 | 77,988 | 29,698 | 52,265 | 35,505 | 13,307 | $872,371 | $597,413 | $220,328 |
| Canada | 2,435 | 196 | 2 | 1,159 | 104 | 1 | 32,380 | 4,678 | 68 |
| Chile | 3,828 | 398 | | 1,848 | 191 | | 36,259 | 4,803 | |
| Cuba | 37,876 | 122,937 | 131,423 | 17,461 | 56,385 | 61,535 | 521,370 | 2,185,800 | 2,242,425 |
| France | 59 | 95 | 68 | 29 | 48 | 35 | 11,975 | 18,703 | 12,933 |
| Germany | 113 | 64 | | 55 | 31 | | 29,870 | 17,272 | |
| Gold Coast | 241,593 | 254,547 | 126,858 | 125,893 | 130,147 | 63,890 | 3,166,498 | 2,942,430 | 1,590,813 |
| India, British | 126,913 | 70,380 | 25,480 | 65,699 | 36,523 | 13,121 | 1,307,436 | 679,232 | 236,945 |
| Netherland India | 552 | 1,126 | | 279 | 631 | | 14,082 | 28,607 | |
| Philippine Islands | | | 4,002 | | | 1,600 | | | 44,075 |
| Union of South Africa | 99 | 209 | | 50 | 119 | | 1,347 | 3,125 | |
| U. S. S. R | 289,867 | 383,949 | 166,043 | 141,070 | 186,736 | 80,673 | 2,716,401 | 3,959,955 | 2,661,557 |
| Other countries | 9 | 30 | 14 | 4 | 14 | 7 | 1,810 | 9,584 | 253 |
| | 813,362 | 911,919 | 483,588 | 405,812 | 446,434 | 234,169 | 8,711,799 | 10,451,602 | 6,919,397 |

## STOCKS

Stocks of manganese ore in bonded warehouses rose for the second successive year and reached a peak of 842,048 long tons containing 418,721 tons of Mn at the end of 1938. This abnormally high level of stocks resulted from low activities in the domestic steel industry and from overbuying in 1937.

## PRICES

Prices of manganese ore according to grade and origin, as quoted by the various trade journals, apply to imported ore and (except for battery ore) are on a unit basis. The unit is 1 percent of 1 long ton (22.4 pounds of contained manganese). Prices of battery-grade ore are quoted on a per-ton basis, with a minimum requirement of manganese dioxide.

The prices in the following table are quoted from the Engineering and Mining Journal.

*Domestic prices of metallurgical manganese ore in 1938, in cents per long-ton unit*

[C. i. f. North Atlantic ports, cargo lots, exclusive of duty]

| | Beginning of year | End of year | | Beginning of year | End of year |
|---|---|---|---|---|---|
| Brazilian, 46-48 percent Mn | $0.46 | $0.27 | South African: | | |
| Chilean, 47 percent Mn | .46 | .28 | 50–52 percent Mn | $0.45 | $0.28 |
| Indian, 50 percent Mn | .45 | .30 | 44–48 percent Mn | .40 | .25 |
| Caucasian, 52–55 percent Mn | .45 | .30 | | | |

According to the Engineering and Mining Journal the prices for chemical (battery-grade) ores per long ton in carload lots during 1938 were as follows: Domestic chemical ores containing 70 to 72 percent manganese dioxide dropped about $5 in August and were quoted at $43 to $47 for the rest of the year, while imported ores containing 80 to 85 percent manganese dioxide were quoted at $45 to $60.

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## CONSUMPTION OF MANGANIFEROUS RAW MATERIALS

The following table shows the indicated consumption of manganiferous raw materials in the United States in 1938. The table does not consider differences in consumers' stocks at the beginning and end of the year. As such stocks are largely imported ore and the import figure used in the table is that for imports for consumption it is thought that the change in stocks would not be great because the manganese ore may be kept in bond until withdrawn for consumption. The duty is then paid, and the ore is reported as imports for consumption.

*Indicated consumption of manganiferous raw materials in the United States in 1938*

| | Ore containing 35 percent or more Mn | | Ore and residuum containing 10 to 35 percent Mn | | Ore containing 5 to 10 percent Mn | |
|---|---|---|---|---|---|---|
| | Long tons | Mn content (percent) | Long tons | Mn content (percent) | Long tons | Mn content (percent) |
| Domestic shipments | [1] 26,344 | 45 | 72,699 | 16 | 275,240 | 7.4 |
| Imports for consumption | 483,588 | 48 | 30,051 | 29 | [2] 75,285 | 7.7 |
| Total available for consumption | 509,932 | 48 | 102,750 | 20 | 350,525 | 7.5 |

[1] Includes shipments from Puerto Rico. [2] Estimated.

Besides the material shown in the foregoing table, 358,200 long tons of ore containing 2 to 5 percent Mn were used presumably in the manufacture of manganiferous pig iron in 1938 compared with 879,800 tons in 1937. Figures are not available for imports of this class of ore.

### METALLURGICAL INDUSTRY

Although some manganese is used in both the ferrous and nonferrous metallurgical industries the bulk is consumed in the manufacture of iron and steel. Most of the ore entering this industry is used in the manufacture of ferromanganese and spiegeleisen, the forms in which manganese usually is added to steel.

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*Chief manganese alloys imported into and made from domestic and imported ores in in United States, 1937–38, in long tons*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Alloy | Manganese | Alloy | Manganese |
| Ferromanganese: | | | | |
| Imported | 29,559 | 23,888 | 26,258 | 21,118 |
| Domestic production | 376,443 | 299,425 | 242,994 | 191,104 |
| From domestic ore [1] | 5,484 | 4,276 | 13,926 | 10,996 |
| From imported ore [1] | 370,959 | 295,149 | 229,068 | 180,108 |
| Total | 406,002 | 323,313 | 269,252 | 212,222 |
| Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported | | 1.32 | | 5.18 |
| Number of plants making ferromanganese | 7 | | 8 | |
| Spiegeleisen: | | | | |
| Imported | 16,841 | [1] 3,368 | 17,248 | [1] 3,450 |
| Domestic production | (2) | (2) | 11,311 | 2,289 |
| From domestic ore [1] | (2) | (2) | 11,060 | 2,249 |
| From imported ore [1] | (2) | (2) | 251 | 40 |
| Total | (2) | (2) | 28,559 | 5,739 |
| Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported | | (2) | | 39.19 |
| Number of plants making spiegeleisen | 3 | | 3 | |
| Total available supply of metallic manganese as alloys | | (2) | | 217,961 |
| Percent of available supply of manganese in— | | | | |
| Ferromanganese and spiegeleisen imported | | (2) | | 11.27 |
| Ferromanganese made from imported ore | | (2) | | 82.63 |
| Spiegeleisen made from imported ore | | (2) | | .02 |
| Ferromanganese made from domestic ore | | (2) | | 5.05 |
| Spiegeleisen made from domestic ore | | (2) | | 1.03 |
| Ferromanganese and spiegeleisen made from domestic ore | | (2) | | 6.08 |
| Spiegeleisen made and imported | | (2) | | 2.63 |
| Total open-hearth and Bessemer steel | 49,722,230 | | 27,844,961 | |

[1] Estimated. [2] Bureau of Mines not at liberty to publish figures.

*Ferromanganese.*—The domestic output of ferromanganese in 1938, which dropped 35 percent from 1937, was produced at the following plants.

Bethlehem Steel Co., Johnstown, Pa.
Carnegie-Illinois Steel Corporation, North Braddock and Etna, Pa.
Colorado Fuel & Iron Corporation, Pueblo, Colo.
Electro Metallurgical Co., Alloy, W. Va.
Jones & Laughlin Steel Corporation, Aliquippa, Pa.
E. J. Lavino & Co., Reusens, Va.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

In addition to the above plants, shipments were made by the Pittsburgh Metallurgical Co., Niagara Falls, N. Y.

The larger part of the ferromanganese produced in this country is made from foreign ores, as shown in the following table.

*Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1934–38*

| Year | Ferromanganese produced | | | Materials consumed (long tons) | | | | Manganese ore used per ton of ferromanganese made (long tons) |
|---|---|---|---|---|---|---|---|---|
| | Long tons | Mn contained | | Manganese ore | | Iron and manganiferous iron ores | Cinder, scale, and purchased scrap | |
| | | Percent | Long tons | Foreign | Domestic | | | |
| 1934 | 139,171 | 78.67 | 109,491 | 256,980 | 853 | 13,933 | 3,304 | 1.853 |
| 1935 | 214,290 | 79.41 | 170,168 | 401,846 | 4,286 | 9,195 | 8,921 | 1.895 |
| 1936 | 316,000 | 79.09 | 249,933 | 595,114 | 5,987 | 12,467 | 2,821 | 1.902 |
| 1937 | 376,443 | 79.54 | 299,425 | 698,052 | 9,444 | 17,511 | 6,017 | 1.879 |
| 1938 | 242,994 | 78.65 | 191,104 | 416,738 | 22,548 | 9,696 | 8,462 | 1.808 |

The sources of the foreign ore used in the domestic production of ferromanganese are shown in the following table.

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*Foreign manganese ore used in manufacture of ferromanganese in the United States, 1934–38, in long tons*

| Source of ore | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Africa | 46,096 | 69,857 | 199,143 | 150,112 | 152,698 |
| Brazil | 55,778 | 47,663 | 86,032 | 112,238 | 64,060 |
| Chile | 451 | 2,941 | 832 | 186 | |
| Cuba | 16,242 | 56,411 | 32,317 | 60,012 | 36,295 |
| India | 21,460 | 76,983 | 105,289 | 62,199 | 55,965 |
| Philippine Islands | | 520 | | | |
| U. S. S. R. | 116,953 | 147,471 | 171,501 | 313,305 | 107,720 |
| | 256,980 | 401,846 | 595,114 | 698,052 | 416,738 |

Shipments of ferromanganese in 1938 decreased 38 percent from 1937. The record of shipments during the last 5 years has been as follows:

*Ferromanganese shipped from furnaces in the United States, 1934–38*

| Year | Long tons | Value | Year | Long tons | Value |
|---|---|---|---|---|---|
| 1934 | 147,947 | $12,345,697 | 1937 | 359,842 | $30,696,748 |
| 1935 | 194,627 | 16,374,328 | 1938 | 223,720 | 19,144,884 |
| 1936 | 322,353 | 24,088,298 | | | |

Although there is a small export trade in ferromanganese, the quantity manufactured in the United States is supplemented by imports. Ferromanganese imported for consumption in 1938 included 257 long tons containing not over 1 percent carbon, 5,999 tons containing over 1 but less than 4 percent carbon, and 20,002 tons containing not less than 4 percent carbon.

*Ferromanganese imported into and exported from the United States, 1934–38*

| Year | Imports for consumption | | | Exports [1] | |
|---|---|---|---|---|---|
| | Gross weight (long tons) | Mn content (long tons) | Value | Gross weight (long tons) | Value |
| 1934 | 23,349 | 18,702 | $1,441,360 | 222 | $12,580 |
| 1935 | 27,240 | 21,830 | 1,731,411 | 131 | 10,389 |
| 1936 | 37,953 | 30,594 | 2,251,951 | 466 | 26,540 |
| 1937 | 29,559 | 23,888 | 2,163,616 | 1,725 | 72,502 |
| 1938 | 26,258 | 21,118 | 1,770,948 | 247 | 18,799 |

[1] Includes spiegeleisen; not separately classified.

Norway supplied 50 percent of the imports in 1938. Distribution of imports by countries is shown in the following table.

*Ferromanganese imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Mn content (long tons) | Value | Mn content (long tons) | Value |
| Canada | 3,385 | $426,759 | | |
| Czechoslovakia | 944 | 57,919 | 3,043 | $211,356 |
| France | 760 | 101,901 | 1,137 | 152,068 |
| Italy | 43 | 5,706 | | |
| Japan | 722 | 84,698 | 308 | 37,118 |
| Netherlands | 282 | 17,033 | 5,843 | 403,561 |
| Norway | 17,468 | 1,447,177 | 10,547 | 953,045 |
| Poland and Danzig | 156 | 9,897 | | |
| United Kingdom | 128 | 12,526 | | |
| Yugoslavia | | | 240 | 13,800 |
| | 23,888 | 2,163,616 | 21,118 | 1,770,948 |

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Customs districts through which imported ferromanganese entered in 1937 and 1938 were as follows:

*Manganese content of ferromanganese imported for consumption in the United States, 1937–38, by customs districts, in long tons*

| Customs district | 1937 | 1938 | Customs district | 1937 | 1938 |
|---|---|---|---|---|---|
| Buffalo | 2,055 | 389 | New Orleans | 913 | 1,126 |
| Chicago | 363 | 1,585 | New York | 499 | 1,090 |
| Connecticut | ---------- | 163 | Oregon | 315 | 334 |
| Galveston | 55 | ---------- | Philadelphia | 1,297 | 3,526 |
| Los Angeles | 1,095 | 96 | Pittsburgh | 9 | ---------- |
| Maryland | 12,605 | 12,157 | San Francisco | 1,415 | 160 |
| Massachusetts | 78 | 39 | Washington (State) | 209 | 131 |
| Michigan | 2,350 | 322 | | | |
| Mobile | 630 | ---------- | | 23,888 | 21,118 |

Stocks of ferromanganese in bonded warehouses at the end of 1938 were 8,392 long tons containing 6,974 tons of Mn compared with 11,788 tons containing 9,690 tons of Mn at the end of 1937.

The quoted prices of ferromanganese dropped $10 per long ton for the last half of 1938, as shown in the following table.

*Prices per long ton of ferromanganese in the United States, 1936–38* [1]

[80 percent—delivered at Pittsburgh]

| Month | 1936 | 1937 | 1938 | Month | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|
| January | $90.13 | $84.79 | $107.49 | July | $80.13 | $107.29 | $97.77 |
| February | 80.13 | 84.79 | 107.49 | August | 80.13 | 107.29 | 97.77 |
| March | 80.13 | 92.29 | 107.49 | September | 80.13 | 107.29 | 97.77 |
| April | 80.13 | 99.79 | 107.49 | October | 80.13 | 107.29 | 97.77 |
| May | 80.13 | 107.29 | 107.77 | November | 80.13 | 107.39 | 97.77 |
| June | 80.13 | 107.29 | 107.77 | December | 82.65 | 107.49 | 97.77 |

[1] Steel, vol. 104, Jan. 2, 1939.

*Spiegeleisen.*—Shipments of spiegeleisen dropped sharply in 1938 and amounted to only 18 percent of the 1937 figure.

*Spiegeleisen produced and shipped in the United States, 1934–38*

| Year | Produced (long tons) | Shipped from furnaces | | Year | Produced (long tons) | Shipped from furnaces | |
|---|---|---|---|---|---|---|---|
| | | Long tons | Value | | | Long tons | Value |
| 1934 | (1) | 45,769 | $1,099,922 | 1937 | (1) | 134,983 | $3,969,822 |
| 1935 | 60,018 | 54,793 | 1,303,574 | 1938 | 11,311 | 24,939 | 80,830 |
| 1936 | 95,137 | 92,336 | 2,249,217 | | | | |

[1] Bureau of Mines not at liberty to publish figures.

Spiegeleisen was manufactured at the following plants in 1938:

E. J. Lavino & Co., Reusens, Va.
New Jersey Zinc Co., Palmerton, Pa.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

In addition to these plants the Keokuk Electro-Metals Co., Keokuk, Iowa, made shipments from stock.

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Most of the spiegeleisen produced in the United States in recent years has been made from domestic raw materials, but 317 long tons of foreign ore containing 48.58 percent Mn were consumed in 1938 in the manufacture of spiegeleisen.

Imports of spiegeleisen for consumption in 1938 increased slightly over 1937. Canada, with 16,783 tons, furnished 97 percent of the supply, while the remaining tonnage came from Norway and the Netherlands.

*Spiegeleisen imported for consumption in the United States, 1934–38*

| Year | Long tons | Value | Year | Long tons | Value |
|---|---|---|---|---|---|
| 1934 | 21,184 | $595,017 | 1937 | 16,841 | $589,766 |
| 1935 | 32,384 | 915,134 | 1938 | 17,248 | 625,480 |
| 1936 | 52,011 | 1,404,983 | | | |

The quoted prices of spiegeleisen at producers' furnaces dropped $5 per long ton July 1 and remained at $28 for the rest of the year.

*Manganiferous pig iron.*—Precise data are not available on the consumption of manganiferous ores in the production of manganiferous pig iron, however 275,240 long tons of domestic ore containing 5 to 10 percent Mn and 358,200 tons containing 2 to 5 percent Mn were shipped in 1938. Foreign manganiferous iron ore (75,285 tons) also was consumed in the manufacture of pig iron. The sources of the foreign ores for the last 3 years are given in the following table. Import figures are not available on ore containing 2 to 5 percent Mn.

*Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1936–38, in long tons*

| Source of ore | Ferruginous manganese ore | | | Manganiferous iron ore | | |
|---|---|---|---|---|---|---|
| | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 |
| Africa: | | | | | | |
| Egypt | 26,244 | 57,176 | | | | |
| Undistributed | | | 11,753 | 3,737 | 446 | |
| Asia: | | | | | | |
| Palestine | | 323 | | | | |
| Philippine Islands | | 2,257 | 2,887 | | | |
| Undistributed | | 2,541 | | | | |
| Australia | 9,127 | | | 94,818 | 140,372 | 61,473 |
| Brazil | | | 2,829 | | | 9,597 |
| Cuba | 103 | | | | | |
| Spain | | | | | 1,658 | |
| Sweden | | | | 4,524 | | 4,215 |
| Undistributed | | 6,982 | 6,005 | | | |
| | 35,474 | 69,279 | 23,474 | 103,079 | 142,476 | 75,285 |

## BATTERY INDUSTRY

Shipments of manganese ore to battery makers by domestic producers in 1938 totaled 4,959 long tons and shipments from Puerto Rico 1,023 tons, indicating a consumption of 5,982 tons of domestic materials in battery manufacture. Imported manganese ore also was consumed in the battery industry, but no figures are available for such imports.

## MISCELLANEOUS INDUSTRIES

Certain manganese ores with peculiar physical or chemical properties are required for the manufacture of special articles in the chemical, ceramic, and glass industries.

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## WORLD PRODUCTION

The following table shows, insofar as statistics are available, the world production of manganese ores from 1934 to 1938 and their average manganese content. Most of the figures are from official statistics of the countries concerned; they are supplemented by data from semiofficial and other sources.

*Manganese ore produced in the principal countries, 1934–38, in metric tons*

[Compiled by R. B. Miller]

| Country [1] | Percent Mn | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| North America: | | | | | | |
| Canada (shipments) | ---------- | ---------- | 91 | 200 | 77 | ---------- |
| Costa Rica | ---------- | ---------- | ---------- | ---------- | 100 | 303 |
| Cuba | 36-50+ | 68,064 | 35,269 | 48,471 | 131,299 | 123,844 |
| Mexico | 40+ | 664 | 3,217 | 3,377 | 17 | 117 |
| United States: | | | | | | |
| Continental (shipments, exclusive of fluxing ore) | 35+ | 26,940 | 26,852 | 32,635 | 40,887 | 25,727 |
| Puerto Rico [3] | 48-51 | 1,738 | 3,412 | 3,058 | 2,381 | 1,039 |
| South America: | | | | | | |
| Argentina [4] | 35-38 | 583 | 439 | 443 | (2) | (2) |
| Brazil | 38-50 | 7,527 | 41,767 | 156,201 | 253,661 | 221,961 |
| Chile [3] | 40-50 | 4,065 | 4,370 | 5,180 | 13,015 | (2) |
| Europe: | | | | | | |
| Bulgaria | 30-45 | ---------- | ---------- | 1,500 | 3,000 | (2) |
| Germany | 30+ | 515 | 224 | 242 | 226 | (2) |
| Greece | 30+ | 1,206 | 423 | 1,680 | 6,952 | (2) |
| Hungary | 35-48 | 10 | 6,291 | 27,228 | 25,088 | 22,221 |
| Italy | 34-37 | 6,941 | 9,127 | 24,132 | 33,532 | (2) |
| Portugal | 40+ | 295 | 158 | 290 | 317 | 999 |
| Rumania | 30-36 | 12,057 | 19,795 | 33,856 | 50,749 | (2) |
| Spain | 31-34 | 3,796 | 1,260 | (5) | (5) | (2) |
| Sweden | 30-50 | 5,832 | 6,495 | 5,943 | 5,845 | (2) |
| U. S. S. R. | 41-48 | 1,821,000 | 2,384,600 | 3,002,000 | 2,700,000 | (2) |
| Yugoslavia | 32-38 | 1,103 | 928 | 2,739 | 4,420 | 3,758 |
| Asia: | | | | | | |
| China [3] | 45-46 | 870 | 827 | 23,794 | 51,446 | 1,247 |
| India: | | | | | | |
| British | 47-52 | 412,827 | 651,779 | 826,498 | 1,068,472 | 901,649 |
| Portuguese | 42-50+ | 3,800 | 4,064 | 2,662 | 4,077 | (2) |
| Indochina | ---------- | ---------- | 1,568 | 3,430 | 5,287 | (2) |
| Japan | 49-51 | 57,165 | 71,659 | 67,753 | (5) | (2) |
| Netherland India | 50-55 | 11,635 | 12,353 | 8,619 | 11,083 | (2) |
| Philippine Islands [3] | 45-50 | ---------- | 519 | 255 | 12,206 | 49,359 |
| Turkey | 30-50 | 13 | 15,600 | 5,200 | 530 | (2) |
| Unfederated Malay States | 30 | 18,948 | 28,504 | 37,366 | 33,319 | 32,483 |
| Africa: | | | | | | |
| Belgian Congo | 56 | ---------- | ---------- | ---------- | 27,471 | (2) |
| Egypt | 30+ | 959 | 87,303 | 134,972 | 186,320 | (2) |
| Gold Coast [3] | 50+ | 371,039 | 437,571 | 417,621 | 535,495 | (2) |
| Morocco: | | | | | | |
| French | 40-50+ | 7,300 | 24,685 | 39,360 | 76,470 | 84,322 |
| Spanish | 38 | ---------- | ---------- | ---------- | 660 | (2) |
| Northern Rhodesia | 30-48 | 2,074 | 4,040 | 3,071 | 2,379 | 2,779 |
| Union of South Africa | 30-51 | 65,497 | 95,450 | 258,244 | 631,194 | 563,762 |
| Oceania: | | | | | | |
| Australia: | | | | | | |
| New South Wales | ---------- | 105 | 150 | 73 | 109 | (2) |
| Queensland | ---------- | ---------- | ---------- | ---------- | 1,052 | (2) |
| South Australia | ---------- | 2 | ---------- | ---------- | ---------- | (2) |
| | ---------- | 2,915,000 | 3,981,000 | 5,179,000 | 5,987,000 | (2) |

[1] In addition to the countries listed Belgium is reported to produce a small quantity of manganese ore, but statistics of output are not available. Czechoslovakia reports a production of manganese ore, but as it has been ascertained that the product so reported averages less then 30 percent Mn and therefore would be considered ferruginous manganese ore under the classification used in this report the output has not been included in the table.
[2] Data not available.
[3] Exports.
[4] Shipments by rail and river.
[5] Estimate included in total.

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*Brazil.*—Production in Brazil was at a lower rate in 1938; exports were 143,670 metric tons in 1938 compared with 225,682 tons in 1937. The drop was due almost entirely to smaller shipments to the United States. On June 7, 1938, the National Iron Ore and Manganese Producers' and Exporters' Association (Sindicato Nacional de Productores e Exportadores de Minerios de Ferro e Manganês) was founded, whose general object is to coordinate, direct, and supervise exploitation of and trade in these commodities. The association plans to maintain an adequate statistical service and a laboratory for the analysis of ores. Membership in the association comprises most of the larger producers.

*Cuba.*—Output by the Cuban-American Manganese Corporation, the principal producer in Cuba, totaled 123,844 metric tons (dried) in 1938, of which 87,419 tons were nodulized concentrates and 36,425 tons were washed, jigged, or sorted ore. Exports were 118,978 tons, of which 88,731 tons were nodulized concentrates and 30,247 tons were washed, jigged, or sorted ore. The latter material contains 39 to 40 percent Mn, while typical cargo analyses of shipments of nodules are as follows:

*Analyses of shipments of nodulized concentrates, percent*

| | | | | | |
|---|---|---|---|---|---|
| Mn | 51.00 | 50.88 | 51.23 | 50.77 | 50.09 |
| Fe | 2.61 | ------ | 2.78 | 2.65 | 3.15 |
| $SiO_2$ | 10.92 | 10.89 | 10.86 | 9.87 | 10.26 |
| $Al_2O_3$ | 3.00 | ------ | 3.44 | 3.60 | 3.85 |
| CaO | ------ | ------ | ------ | 7.24 | 5.62 |
| P | .088 | .094 | .083 | .091 | .092 |
| Moisture | .08 | 1.06 | .62 | .10 | 1.54 |

It was reported that mining operations were begun in the El Sabalo area in Pinar del Rio in 1938.

*Gold Coast.*—The African Manganese Mines Co., Ltd., which operates at Nsuta near Tarkwa, Wasaw district, Western Province, is the only producer of manganese ore in Gold Coast Colony.

*India, British.*—Water-borne exports from India, normally the second largest producer in the world, decreased to 582,492 metric tons in 1938 from 996,934 in 1937. These figures do not include exports through Mormugao, which were 173,383 tons in 1937.

*Union of South Africa.*—Output in the Union of South Africa in 1938 fell slightly below the peak figure established in 1937. Virtually all the production came from deposits north of Postmasburg in Griqualand West, Cape Province. All Cape ore is exported; exports in 1938 were 319,051 metric tons. Several grades of ore are shipped containing from 28 to over 50 percent Mn, and a large part of the shipments consist of ore containing less than 45 percent Mn. Small quantities (965 metric tons in 1938) of wad, together with some high-grade pyrolusite and psilomelane, were produced in the Krugersdorp district, Transvaal, for local consumption only.

*U. S. S. R.*—Data showing production in the U. S. S. R. in 1938 are not available. Two mining districts, Chiaturi and Nikopol, supply the bulk of the Russian output. Virtually all the Chiaturi ore is exported, while Nikopol supplies the bulk of the domestic consumption. Other deposits in the Urals and Western Siberia supply the remaining domestic requirements. Exports for the first 9 months of 1938 were 269,930 metric tons.

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# CHROMITE

By Robert H. Ridgway

## SUMMARY OUTLINE


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| Metallurgical | 598 | | |


World production of chromite in 1938 receded from the all-time peak established in 1937. Relatively small increases in output in Turkey and the Union of South Africa were more than offset by the drastic decreases in Southern Rhodesia and Cuba. Although complete data are not yet available it is doubtful whether the 1938 total will reach 1,000,000 long tons. Exports from all producing countries except Turkey were lower in 1938 than in 1937, reflecting the lower demand (principally in the United States).

Lower prices accompanied the sharp drop in demand, but, unlike 1937, ample supplies were available throughout the year. Imports into the United States decreased 36 percent, and delivery was suspended on some contracts to American consumers because of slack demand and stocks on hand. Exploration and development work continued in the Western States. One domestic consumer of chromite has been very active in the field during the past 2 years. The United States Chrome Mines, Inc., plans to expand production materially in 1939. Output is to come from Eldorado and San Luis Obispo Counties, Calif.

The following table compares the salient statistics of the chromite industry in the United States during the last 5 years with the yearly average from 1925 to 1929.

*Salient statistics of the chromite industry in the United States, 1925–29 (average) and 1934–38*

| | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Apparent available supply: | | | | | | |
| Imports—long tons | 224,357 | 192,297 | 259,063 | 324,258 | 553,916 | 352,085 |
| Shipments from domestic mines—long tons | 276 | 369 | 515 | 269 | 2,321 | 812 |
| | 224,633 | 192,666 | 259,578 | 324,527 | 556,237 | 352,897 |
| Price per long ton at New York, approximate average of all grades | $22.46 | $19.00 | $17.70 | $17.76 | $22.55 | $21.59 |
| Imports: | | | | | | |
| Africa [1]—percent of total | 63 | 26 | 36 | 37 | 50 | 48 |
| Cuba—do | 15 | 26 | 18 | 22 | 17 | 11 |
| Greece—do | 9 | 12 | 8 | 8 | 5 | 3 |
| New Caledonia—do | 6 | 10 | 22 | 20 | 9 | 8 |
| Turkey—do | ---------- | 15 | 6 | 6 | 7 | 6 |
| U. S. S. R.—do | ---------- | 10 | 1 | 1 | ---------- | ---------- |
| Other countries—do | 7 | 1 | 9 | 6 | 12 | [2] 24 |
| World production—long tons | 428,000 | 589,000 | 780,000 | 1,051,000 | (3) | (3) |

[1] Originated in Southern Rhodesia and Union of South Africa.
[2] Principally from the Philippine Islands.
[3] Figures not yet available.



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Figure 1 shows trends in consumption, prices, and domestic shipments during the past 14 years.

*Emergency stock pile.*—Chromite is listed by the War Department as one of the four mineral commodities constituting the first priority class for stock-pile reserves. Its importance is appreciated more readily when it is realized that the steel industry accounts for three-fourths of the domestic consumption. The strategic nature of

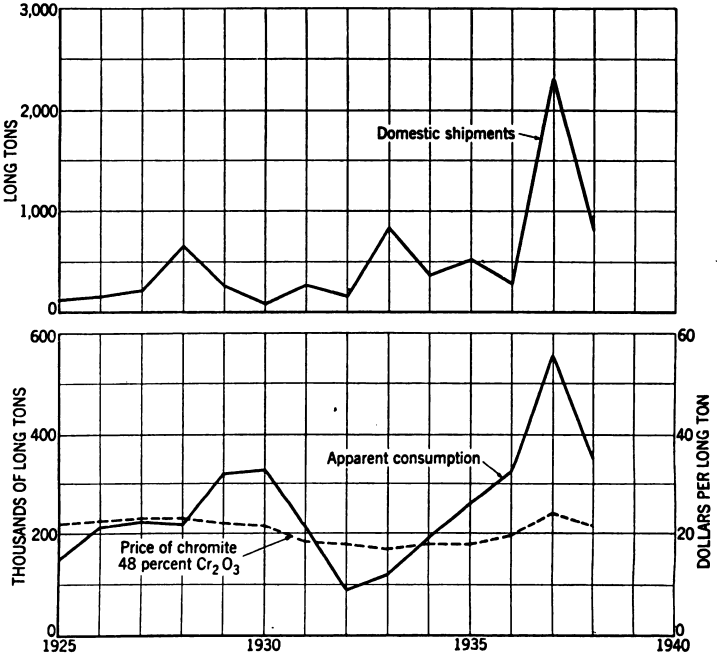


FIGURE 1.—Trends in consumption, price, and domestic shipments of chromite in the United States, 1925-38.

chromite is demonstrated in the following table, which shows domestic production, imports, and apparent supply from 1910 through 1938.

Several bills have been introduced into Congress looking to the purchase of stock piles of strategic materials, and hearings on the subject have been held by both the House and Senate military affairs committees. The Senate recently (April 3, 1939) passed a bill (S. 572) which provides $10,000,000 a year for the fiscal years 1940 to 1943 (the fiscal year ends June 30) for the purchase of strategic and critical materials. A similar bill (H. R. 5191) has been reported to the House by the House Military Affairs Committee. This bill, however, provides a total of $100,000,000 for four years.

During the past 2 years the Navy Department has received a small appropriation to provide stock piles of strategic commodities, and specifications and schedules for the purchase of 2,000 short tons of metallurgical chromite were released late in 1937. The bids were called for January 4, 1938, and a domestic producer was the lowest bidder. Accordingly he was awarded the contract, which called for delivery within 120 days. After two time extensions the producer

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had not delivered and asked for a further extension which was not granted, so the contract was canceled. Bids were then called for February 23, 1939, and the award was made on March 14, 1939, to E. J. Lavino & Co., which will supply ore from Southern Rhodesia.

*Domestic production, imports, and apparent available supply of chromite in the United States, 1910–38, in long tons*

| Year | Domestic production (shipments from mines) | | | | Imports | Apparent available supply [1] |
|---|---|---|---|---|---|---|
| | California | Oregon | Other States [2] | Total | | |
| 1910 | 205 | | | 205 | 38,579 | 38,784 |
| 1911 | 120 | | | 120 | 37,540 | 37,660 |
| 1912 | 201 | | | 201 | 53,929 | 54,130 |
| 1913 | 255 | | | 255 | 65,180 | 65,435 |
| 1914 | 506 | | 85 | 591 | 74,686 | 75,277 |
| 1915 | 3,281 | | | 3,281 | 76,455 | 79,736 |
| 1916 | 43,758 | 3,099 | 178 | 47,035 | 115,945 | 162,980 |
| 1917 | 36,774 | 6,701 | 250 | 43,725 | 72,063 | 115,788 |
| 1918 | 63,147 | 18,454 | 829 | 82,430 | 100,142 | 182,572 |
| 1919 | 3,272 | 538 | 1,269 | 5,079 | 61,404 | 66,483 |
| 1920 | 1,416 | 955 | 131 | 2,502 | 150,275 | 152,777 |
| 1921 | 123 | 159 | | 282 | 81,836 | 82,118 |
| 1922 | 163 | 79 | 113 | 355 | 90,081 | 90,436 |
| 1923 | 69 | 78 | 80 | 227 | 129,693 | 129,920 |
| 1924 | 188 | 100 | | 288 | 118,343 | 118,631 |
| 1925 | 83 | | 25 | 108 | 149,739 | 149,847 |
| 1926 | 91 | | 50 | 141 | 215,464 | 215,605 |
| 1927 | [3] 201 | | | 201 | 222,360 | 222,561 |
| 1928 | 652 | | 8 | 660 | 216,592 | 217,252 |
| 1929 | 269 | | | 269 | 317,630 | 317,899 |
| 1930 | 80 | | | 80 | 326,617 | 326,697 |
| 1931 | 268 | | | 268 | 212,528 | 212,796 |
| 1932 | 155 | | | 155 | 89,143 | 89,298 |
| 1933 | 843 | | | 843 | 116,511 | 117,354 |
| 1934 | 369 | | | 369 | 192,297 | 192,666 |
| 1935 | 515 | | | 515 | 259,063 | 259,578 |
| 1936 | 269 | | | 269 | 324,258 | 324,527 |
| 1937 | 2,033 | 288 | | 2,321 | 553,916 | 556,237 |
| 1938 | 812 | | | 812 | 352,085 | 352,897 |

[1] Domestic production plus imports; no exports recorded, 1910–38.
[2] Maryland, North Carolina, Washington, and Wyoming.
[3] According to the Division of Mines and Mining, Department of Natural Resources, California.

## DOMESTIC PRODUCTION

Domestic production, as measured by shipments from the mines, decreased from 2,321 long tons in 1937 to only 812 tons in 1938. The entire output came from California and was produced in Eldorado, Placer, and Napa Counties. With the exception of 2 carloads the 1938 output came from the United States Chrome Mines, Inc., in Eldorado County where a mill with a capacity of 200 tons a day has been installed. It was reported that shipments from this property in 1938 averaged 49 percent $Cr_2O_3$. Aside from production and development work in California, exploration was continued in other Western States. Certain features of characteristic deposits in California and Oregon have been described by Allen.[1] With regard to deposits in Oregon, Allen[2] has the following to say:

Chromite in Oregon occurs in the southwestern and northeastern parts of the State, in rocks of the peridotite or serpentine types. The deposits vary in form from thin stringers through narrow lenses to thicker and shorter kidneys and in size from a few inches up to masses whose outcrops are 40 feet in width and 150 feet or more in length. Only 11 of the deposits visited in Oregon had

[1] Allen, John Eliot, Geological Features of West Coast Chromite Deposits: Min. and Met., vol. 20, No. 386, February 1939, p. 100.
[2] Allen, John Eliot, Chromite Deposits in Oregon: Oregon Dept. of Geol. and Min. Ind. Bull. 9, 1938, p. 11.

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individual kidneys of ore with visible outcrops larger than 5 feet wide and 10 feet long. When ore bodies occur in groups, which is common, individual masses often follow a recognizable scheme of orientation; they may be in line, staggered or overlapping, parallel, or irregularly placed with respect to each other. Nearly all the ore bodies are considerably broken and faulted, and they usually lie in a sheared and altered zone in the country rock.

The same publication also contains chapters entitled "The Present Commercial Aspect of Western Chrome Ores," by H. F. Byram, and "Preliminary Geophysical Investigation on the Sourdough Chromite Deposit in Oregon," by F. W. Lee.

Chromite is known to occur in the basic rocks of western North Carolina and northern Georgia, but there has been little or no production from this area since the World War. The Tennessee Valley Authority has investigated the deposits in this area, and Hunter [3] reports as follows:

> It is not practical under the present economic conditions to mine chromite from the small deposits in North Carolina and Georgia, but in case of necessity a limited amount of chromite can be quickly recovered from the several small deposits.

In connection with its program of devising low-cost methods of utilizing low-grade domestic sources of minerals, particularly strategic minerals, the Bureau of Mines has developed methods of concentrating western chromite ores and producing pure chromium chloride cheaply.[4]

*Chromite (ores and concentrates) shipped from mines in the United States, 1934–38*

[All from California except in 1937 as indicated]

| Year | Ore containing 45 percent or more chromic oxide | | Ore containing 35 to 45 percent chromic oxide | | Total | |
|---|---|---|---|---|---|---|
| | Long tons | Value | Long tons | Value | Long tons | Value |
| 1934 | 320 | (1) | 49 | (1) | 369 | $4,653 |
| 1935 | 74 | (1) | [2] 441 | (1) | [2] 515 | [2] 6,163 |
| 1936 | (3) | (3) | [2] 269 | [3] $2,978 | 269 | 2,978 |
| 1937 | [4] [5] 2,006 | [4] [5] $11,568 | [2] [5] 315 | [2] [5] 3,320 | [2] [4] 2,321 | [2] [4] 14,888 |
| 1938 | [5] 812 | [5] 10,730 | (5) | (5) | 812 | 10,730 |

[1] Included in total value; Bureau of Mines not at liberty to publish figures separately.
[2] Includes a small quantity of ore containing less than 35 percent chromic oxide.
[3] Ore containing 45 percent or more chromic oxide included with ore containing 35 to 45 percent.
[4] Includes 288 long tons of ore valued at $880 shipped from mines in Oregon, a small part of which contained 35 to 45 percent chromic oxide.
[5] A small quantity of ore containing 35 to 45 percent chromic oxide included with ore containing 45 percent or more.

## IMPORTS [5]

Imports of chromite in 1938 decreased 36 percent from the record total of 1937. This large decline was shared by all the principal sources except the Philippine Islands, from which imports increased 79 percent. The increase from the Philippines resulted from hold-over contracts and shipping on consignment, and much of the ore was in storage at the close of the year. The chromite imported in 1938 contained 46.5 percent chromic oxide. Of the principal imports

[3] Eckel, E. C., Hunter, C. E., and Mattocks, P. W., Iron, Chromite, and Nickel Resources of the Tennessee Valley Region: T. V. A. Geol. Bull. 10, April 1938, p. 20.
[4] Dean, R. S., and others, Progress Reports—Metallurgical Division. 25. Annual Report of the Metallurgical Division, Fiscal Year 1937–38: Bureau of Mines Rept. of Investigations 3419, 1938, pp. 7–8, 41.
[5] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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in 1938, those from New Caledonia had the highest content of chromic oxide (54 percent) and those from Cuba the lowest (32 percent).

*Crude chromite imported into the United States, 1934–38, by countries*

| Country | 1934 (long tons) | 1935 (long tons) | 1936 (long tons) | 1937 (long tons) | 1938 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Long tons | | Value |
| | | | | | Gross weight | Chromic oxide content | |
| Africa [1] | 48,848 | 92,682 | 120,011 | 277,420 | 168,299 | 80,140 | $2,621,404 |
| Cuba | 49,370 | 47,743 | 69,963 | 93,098 | 39,529 | 12,773 | 198,173 |
| Greece | 23,301 | 20,692 | 26,688 | 24,583 | 12,000 | 5,125 | 190,755 |
| India, British | 400 | 14,926 | 14,795 | 23,939 | 4,051 | 1,883 | 53,132 |
| New Caledonia | 19,530 | 55,686 | 65,450 | 51,831 | 28,520 | 15,270 | 388,534 |
| Philippine Islands | | 787 | 4,986 | 43,648 | 78,233 | 38,221 | 915,221 |
| Turkey | 28,730 | 16,060 | 19,490 | 39,391 | 20,392 | 9,650 | 469,145 |
| U. S. S. R. | 19,937 | 3,412 | 2,310 | | | | |
| Other countries | 2,181 | 7,075 | 565 | 6 | 1,061 | 508 | 18,528 |
| | 192,297 | 259,063 | 324,258 | 553,916 | 352,085 | 163,570 | 4,854,892 |

[1] Originated in Southern Rhodesia and Union of South Africa; recorded by Foreign and Domestic Commerce as imported from Union of South Africa, Other British South Africa, Other British West Africa, and Mozambique.

The following tables give imports of chromium alloys and compounds into the United States from 1934 to 1938.

*Chromium compounds imported for consumption in the United States, 1934–38*

| Year | Chromic acid | | Chromate and bichromate of potash | | Chromate and bichromate of soda | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| 1934 | 2,149 | $1,011 | 22 | $5 | 110 | $32 |
| 1935 | 4,281 | 2,198 | | | | |
| 1936 | 2,685 | 1,225 | 1,653 | 469 | 909 | 198 |
| 1937 | 2,310 | 1,184 | 672 | 330 | | |
| 1938 | 525 | 614 | 551 | 163 | | |

*Ferrochrome or ferrochromium and chrome or chromium metal imported for consumption in the United States, 1934–38, in long tons*

| Class | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Ferrochrome or ferrochromium— | | | | | |
| Containing 3 percent or more carbon (chromium content) | | 30 | 4 | 96 | (1) |
| Containing less than 3 percent carbon (gross weight) | 110 | | 104 | 248 | 175 |
| Chrome or chromium metal | 16 | 49 | 57 | 78 | 39 |

[1] 60 pounds.

## CONSUMPTION

Owing to lack of data concerning consumers' stocks it is impossible to estimate accurately the total consumption of chromite in the United States. However, the apparent available supply decreased from the record total of 1937 but was larger than for any other year. Data since 1910 are given in a preceding table.

The steel industry consumes more than three-fourths of the supply of chromite either as a refractory or as the raw-material source of an

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important alloying element. With the slump in the steel industry, a decline in the demand for chromite ensued. The domestic automobile industry, one of the important users of alloy steels and chromium plating, decreased its output from 4,809,565 cars in 1937 to 2,489,635 in 1938, the lowest since 1933. The construction industry uses stainless steel for decorative purposes and large quantities of chromium-plated plumbing fixtures. Activity in this field, which has been increasing since 1933, improved over 1937 but was only about three-fourths of the average annual volume from 1920 to 1929, inclusive.

## USES

Industrial uses of chromite fall into three groups: Metallurgical, refractory, and chemical.

*Metallurgical.*—Chromium is one of the principal elements used in the manufacture of alloy steel. For this purpose most of the chromite is converted to ferrochromium in the electric furnace before it is added to the steel bath, although one domestic concern makes chromium-alloy steels in the electric furnace directly from alloy-steel scrap, mild-steel scrap, and chromite. Although chromium is used in a number of alloy steels, its largest and best-known use is in the manufacture of stainless steels. A new process has been developed for introducing chromium into steel, permitting production of chromium steels in the open-hearth furnace as well as the electric furnace.[6]

In recent years chromium plating has had a wide field of uses and has become important industrially, but the amount of raw material consumed is small owing to the thinness of the layer of metal deposited.

*Refractory.*—Chromite with certain physical and chemical properties is used for refractories. Aside from its use in bricks, lump and ground chromite and chromite cements are used extensively in building and patching furnaces.

According to the Bureau of the Census the production of chrome and magnesite brick was 22,758,000 brick valued at $6,726,943 in1937 compared with 12,112,000 brick valued at $3,424,726 in 1935; stocks were 9,340,000 brick at the end of 1937 compared with 3,228,000 brick at the end of 1935.

Domestic trade-journal quotations for chromite brick dropped from $49 to $47 per short ton in May 1938.

*Chemical.*—In addition to the chromite used in the manufacture of chromic acid for electroplating, considerable chromite is consumed in chemicals employed principally in the dyeing, tanning, and pigment industries.

According to the Bureau of the Census the production of sodium bichromate and chromate was 48,697 short tons valued at $5,925,611 in 1937 compared with 42,325 tons valued at $4,762,728 in 1935. The production of chromic acid was 8,997,337 pounds valued at $1,260,477 in 1937 compared with 6,723, 304 pounds valued at $887,842 in 1935.

## PRICES

Prices of chromite quoted in the domestic trade journals are for imported ore and are given in dollars per long ton c. i. f. North Atlantic ports. The quotations are largely nominal. According to Steel, chromite containing 48 percent chromic oxide was quoted at $25.50 to

[6] Steel, Progress in Steelmaking: Vol. 104, No. 1, Jan. 2, 1939, pp. 314-315.

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$26.50 at the beginning of 1938. Price decreases carried the quotation down to $23 to $24 during the last quarter of the year. Ore with a lower chromic oxide content usually brings a lower price.

## WORLD PRODUCTION

Complete data are not yet available on world output of chromite in 1938. The large drop in the output of Southern Rhodesia, the principal producer in 1937, probably will result in a lower world figure in 1938 than in 1937 despite increases in some other countries. Excluding the U. S. S. R., for which no data are available for 1937 and 1938, Turkey was the largest producer in 1938, followed by Southern Rhodesia and the Union of South Africa.

*World production of crude chromite, 1934–38, by countries, in metric tons*

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia (New South Wales) | 1,744 | 605 | 422 | 466 | (1) |
| Brazil [2] | | 5 | 3,890 | 2,980 | (1) |
| Bulgaria | 85 | 325 | 270 | 2,350 | (1) |
| Canada (shipments) | 101 | 1,037 | 837 | 3,876 | |
| Cuba [3] | 50,162 | 48,509 | 71,086 | 94,592 | 40,163 |
| Cyprus (shipments) | 982 | 1,198 | 508 | 1,641 | (1) |
| Greece | 30,694 | 29,779 | 47,347 | 52,620 | (1) |
| Guatemala [3] | 805 | | | | |
| India, British | 21,922 | 39,755 | 50,280 | 63,307 | (1) |
| Japan | 27,222 | 36,309 | 39,039 | (1) | (1) |
| Levant | | 800 | | | (1) |
| New Caledonia | 55,182 | 55,311 | 47,832 | 48,022 | (1) |
| Norway | 42 | | | 176 | (1) |
| Philippine Islands [3] | | 1,292 | 11,891 | 69,856 | 66,911 |
| Southern Rhodesia | 72,099 | 105,913 | 183,395 | 275,617 | 186,019 |
| Turkey (Asia Minor) | 119,844 | 150,472 | 163,880 | 192,508 | [4] 205,000 |
| Union of South Africa | 61,357 | 90,430 | 175,669 | 168,620 | 183,570 |
| U. S. S. R. | 127,400 | 177,900 | 217,000 | (1) | (1) |
| United Kingdom | | | | 305 | (1) |
| United States (shipments) | 375 | 523 | 273 | 2,358 | 825 |
| Yugoslavia | 28,314 | [5] 52,367 | [5] 54,044 | [5] 59,932 | [5] 51,000 |
| | 598,000 | 793,000 | 1,068,000 | (1) | (1) |

[1] Data not yet available.
[2] Exports.
[3] Imports into the United States.
[4] Estimated.
[5] Crude ore.

## WORLD TRADE

Except for the U. S. S. R. the principal producing countries consume only small quantities of chromite, and the major consuming countries produce only a small fraction of their requirements. The bulk of the chromite produced thus enters international trade. World exports were lower in 1938 than in 1937 when a record figure was established. Turkey, Southern Rhodesia, and the Union of South Africa were the principal exporters.

Figures on imports of chromite into consuming countries are not yet complete, but available data indicate that the three principal importing countries, in order of quantity, were the United States, Germany, and Norway.

A brief summary of the activities in the principal chromite producing and consuming countries follows.

*Canada.*—A small quantity of chromite is produced annually in the Thetford-Black Lake area of the Eastern Townships of Quebec, but no shipments were reported for 1938. The Asbestos Corporation of



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Canada has been mining chromite at one of its properties in the Thetford asbestos field, southern Quebec. Development work on the property at Obonga Lake near Collins, Ontario, by the Chromium Mining & Smelting Corporation did not reveal a deposit of economic importance. The company, however, is proceeding with its metallurgical developments using ore from foreign sources. The process, it is claimed, permits production of low-carbon ferrochromium from low-grade chromite.

*Cuba.*—The entire Cuban output moves to the United States; imports into the United States from Cuba in 1938 were 40,163 metric tons compared with 94,592 tons in 1937. Cuban ores have a low content of $Cr_2O_3$ and are used in the refractory industry.

*Cyprus.*—The milling plant of the Cyprus Chrome Co., Ltd., at Ayios Nikolaos was completed about the middle of 1937. Owing to technical difficulties and the necessity of installing additional machinery, the plant was not in full operation at the beginning of 1938, but a trial shipment of about 500 tons of concentrates in 1937 averaged 51.2 percent $Cr_2O_3$. Concentration is done on magnetic separators, wet classifiers, and tables, and the plant is reported to have a capacity of 50 tons of concentrates per day. Known reserves at the Kokkinorotsos mine were increased as a result of development work.

*France.*—France depends on foreign sources for its domestic requirements. Imports in 1938 totaled 40,178 metric tons of which 3,305 came from French colonies compared with 38,171 tons with no shipment from the colonies in 1937. New Caledonia is the only French colony where any appreciable amount of chromite is found, but recently occurrences of chromite have been reported in Dahomey.[7]

*Germany.*—Germany does not produce chromite. Imports were 176,406 metric tons in 1938 compared with 132,162 tons in 1937. Of the 1938 total, 34 percent came from the Union of South Africa and 30 percent from Turkey. Chromite trade between the Union of South Africa and Germany may be expanded as a result of a trade agreement between the two countries concluded late in 1938.

*Greece.*—Exports of chromite from Greece were 35,661 metric tons in 1938 compared with 55,945 tons in 1937. Of the 1938 total, 18,160 tons went to Germany compared with 11,245 tons in 1937. The principal mines are those of the Société Union Minière at Xinia, northwest of Lamia, and of A. Apostolides at Tsagli, west of Volos.

*India.*—Production data for India in 1938 are not yet available, but exports showed a large decline. Water-borne exports dropped sharply to 18,506 metric tons in 1938 from 37,680 tons in 1937; however, these figures do not include exports through Mormugao, which amounted to 13,495 tons in 1937. The largest output comes from Baluchistan and Mysore State. The chief mines in Baluchistan are near Hindubagh in the Zhob Valley.

*New Caledonia.*—Preliminary figures show that exports of chromite from New Caledonia in 1938 were 39,780 metric tons compared with 69,753 tons in 1937. A large part of the New Caledonian ore comes from two mines, the Tiebaghi mine operated by British interests and the Fantouche mine operated by American interests. New Caledonian ores are of high grade.

[7] Chermette, A., Le Gisement de chromite de Bontomo, Haut-Dahomey: Service des Mines, French West Africa, Bull. 1, 1938, pp. 69-73.

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A new mining company, known as the Société d'Exploitation de la mine Chagrin, with a capital of 500,000 francs has been organized in New Caledonia for the purpose, among other things, of acquiring and operating the Chagrin chromite mine.

*Norway.*—Imports of chromite into Norway in 1938 increased to 50,023 metric tons from 32,718 tons in 1937. Much of the chromite sent to Norway is smelted into ferrochromium, because of the available electric energy, and exported. Exports of ferrochromium, however, decreased to 11,603 tons in 1938 from 14,883 tons in 1937.

*Philippine Islands.*—The declining chromite market affected adversely the new chromite mining industry in the Philippines. Most of the ore comes from three mines, the Florannie, the Acoje, and the Consolidated. The first two mines yield ore that is shipped to metallurgical consumers, while the third mine yields a product low in $Cr_2O_3$ but high in $Al_2O_3$, which is shipped to manufacturers of refractory materials. The Florannie and Consolidated mines are operated by the Benguet Consolidated Mining Co., and Acoje is a Marsman property. Despite unfavorable market conditions, work at Florannie continued throughout the year in an effort to exhaust the ore body and withdraw. At the end of the year, according to the company report, only 1,500 tons remained in the mine. Production in 1938 was 20,982 tons. Operations at Consolidated, which amassed a stock of 25,000 tons, were suspended in May due to lack of orders. Exports from the Philippines in 1938 were 66,911 metric tons compared with 69,856 tons in 1937.

*Southern Rhodesia.*—Output in 1938 decreased 33 percent from the record figure in 1937 and amounted to 186,019 metric tons. Exports were 117,300 tons for the first 6 months of 1938.

Present output comes from two districts (the Selukwe district and along the great dike). Foremost among the Rhodesian chromite deposits are those in the Selukwe district where, at present, three mines are producing.[8] These are the Railway Block, the Selukwe Peak, and the Iron Peak. They are situated 1½, 8, and 4 miles, respectively, from Selukwe. Most of the ore mined from underground workings is extracted by top slicing. The bulk of the ore is shipped direct after hand sorting and blending. Only a small proportion is treated; concentration is accomplished by classifiers, jigs, and tables.

Much of the Rhodesian output is controlled by a British syndicate. Early in 1938 the independent producers formed an association to facilitate marketing of their outputs.

*Sweden.*—Imports of chromite into Sweden decreased from 71,821 metric tons in 1937 to 49,627 tons in 1938. Exports of ferrochromium from Sweden were 13,124 tons in 1937.

*Turkey.*—Despite the apparent curtailment in world output of chromite in 1938, the production of Turkey continued to climb. Output may have exceeded 200,000 metric tons for the first time. Virtually all the ore is exported as there is little or no domestic demand; exports in 1938 were 208,055 metric tons, an increase of 5 percent over the 198,459 tons exported in 1937.

The principal producers of chromite in Turkey are the Société Anonyme Turque des Chromes de l'Est a Guleman (State), Société Miniere de Fethiye (French), Société Turque de Minerais (Swiss-

[8] Musgrave, J., Chrome Mining at Selukwe, Southern Rhodesia: Trans. Inst. Min. and Met., Nov. 17, 1938, pp. 1–16.

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German), and Société Anonyme Turque de Chrome (Turkish). In addition there are several small companies. Production continued at the newly developed deposits at Guleman some 20 miles from the railroad at Ergani. An aerial tramway connects the mines with the Ergani-Diyarbekir Railway, and the ore is transported by rail to the port of Mersin. The district is rapidly becoming one of the most important chromite-mining centers in the world. Although most of the chromite is destined for export, plans call for the installation of a plant at Kutahya for the manufacture of ferrochromium. The following are typical analyses of commercial chromite exported from the Guleman district:

| | *Percent* | |
|---|---|---|
| $Cr_2O_3$ | 49.00 | 52.00 |
| $SiO_2$ | 2.00 | 2.25 |
| FeO | 10.00 | 10.75 |
| MgO | 16.00 | 18.00 |
| $Al_2O_3$ | 16.00 | 17.00 |

*Union of South Africa.*—Output in the Union of South Africa likewise increased in 1938 when a record production of 183,570 metric tons was recorded—9 percent more than the 1937 total. Exports, however, declined appreciably and were 117,562 tons in 1938 compared with 169,537 tons in 1937. Reductions in railway freights to the ports have aided the competitive position of South African chromite.

*U. S. S. R.*—The U. S. S. R. is one of the largest producers of chromite. Output in recent years has been increasing and in 1936 was 217,000 metric tons; figures for 1937 and 1938 are not yet available. Exports are small as the output is consumed in domestic industries.

*United Kingdom.*—Imports of chromite into the United Kingdom in 1937 were 45,573 metric tons. The imports are used in the chemical and refractory industries, as no ferrochromium is made in the United Kingdom. Imports of ferrochromium, largely from Norway and Sweden, were 10,654 tons in 1938 compared with 18,432 tons in 1937.

*Yugoslavia.*—Production in Yugoslavia in 1938 was 51,000 metric tons, and exports were 23,310 tons. The Allatini Mines, Ltd., the principal producer, operates the mines at Orasje, 26 kilometers northwest of Skoplje.

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# NICKEL AND COBALT

By H. W. Davis [1]

## SUMMARY OUTLINE


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## NICKEL

The demand for nickel in the United States in 1938 was adversely affected by the substantial recession of activity in the iron and steel industry, which uses the major portion of nickel. There was also a marked decline in the demand for nickel in most other outlets Precise data on domestic nickel consumption are not available, but the 1938 total may be estimated roughly to have been 22,000 short tons, a decrease of about 50 percent from 1937. As usual, domestic production of primary metal was insignificant (416 short tons), and the output of secondary nickel totaled only 2,300 short tons. The domestic supply was derived chiefly from imports, largely from Canada. Domestic quotations for electrolytic nickel remained unchanged at 35 cents a pound throughout 1938.

In contrast to the marked reduction in the United States, consumption in Europe and elsewhere showed little change in 1938; consequently, world consumption (estimated at 102,000 short tons in 1938) was only about 16 percent less than in 1937

Canada furnished about 88 percent of the world's nickel The International Nickel Co. of Canada, Ltd , alone supplied more than 80 percent of the total nickel used in 1938.

*Salient statistics for nickel, 1936–38*

| | 1936 | 1937 | 1938 |
|---|---|---|---|
| United States: | | | |
| Production (all byproduct of copper refining)—short tons | 107 | 219 | 416 |
| Secondary production—do | 1,965 | 2,400 | 2,300 |
| Imports [1]—do | 53,141 | 54,438 | 29,546 |
| Exports [2]—do | 4,078 | 4,473 | 6,564 |
| Price per pound [3]—cents | 35 | 35 | 35 |
| Canada: | | | |
| Production—short tons | 84,870 | [4] 112,453 | 105,337 |
| Imports—do | 467 | 491 | 491 |
| Exports—do | 86,819 | 111,385 | 98,852 |
| World production (approximate)—do | 98,400 | 127,000 | 120,000 |

[1] Excludes "All other manufactures of nickel"; weight not recorded.
[2] Excludes "Manufactures"; weight not recorded.
[3] Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.
[4] Excludes small quantity produced in British Columbia.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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Search for commercial deposits of nickel in the United States was under way in 1938, and prospecting and development were reported at several localities. Allsman [2] describes the mining of 55 tons of nickel-bearing rock from a prospect in southern Nevada by hand methods. The geology, mineralogy, and problems related to future development also are discussed briefly. Preliminary work on copper-nickel ores from the Bunkerville (Nev.) district was begun at the Boulder City laboratory of the Bureau of Mines. The nickel deposits at Webster and Democrat, N. C., are discussed in a recent report by the Tennessee Valley Authority.[3]

Because of the interest that has been centered lately on strategic and critical minerals from a military standpoint, as well as the fact that nickel has been classed by the Army and Navy Munitions Board as a strategic mineral, it seems fitting at this time to present a historic table comprising data on production and consumption since 1911.

*Production, imports, exports, and apparent consumption of nickel in the United States, 1911–38, nickel content in short tons*

| Year | Primary | | | | Secondary production |
|---|---|---|---|---|---|
| | Domestic production (byproduct of copper refining) | Imports | Exports | Apparent consumption | |
| 1911 | 445 | 14,915 | 12,350 | 2,810 | [1] |
| 1912 | 328 | 23,159 | 12,908 | 10,579 | [1] |
| 1913 | 241 | 23,723 | 14,587 | 9,377 | [1] |
| 1914 | 423 | 17,549 | 13,798 | 4,174 | [1] |
| 1915 | 822 | 28,300 | 13,209 | 15,913 | [1] |
| 1916 | 918 | 36,325 | 16,702 | 20,541 | [2] 816 |
| 1917 | 402 | 37,763 | 10,996 | 27,169 | [2] 860 |
| 1918 | 441 | 36,613 | 8,735 | 28,319 | 1,393 |
| 1919 | [2] 511 | 18,330 | 1,905 | 16,936 | 2,447 |
| 1920 | [2] 365 | 24,246 | 608 | 24,003 | 2,200 |
| 1921 | 111 | 2,198 | 213 | 2,096 | 945 |
| 1922 | 208 | 7,472 | [4] 3,200 | 4,500 | 1,512 |
| 1923 | 100 | 20,398 | [4] 600 | 19,900 | 1,550 |
| 1924 | 191 | 18,542 | [4] 900 | 17,800 | 2,240 |
| 1925 | 272 | 21,601 | [4] 1,200 | 20,700 | 2,300 |
| 1926 | 323 | [4] 19,300 | [4] 700 | 18,900 | 3,050 |
| 1927 | 860 | [4] 17,900 | [4] 900 | 17,900 | 3,380 |
| 1928 | 522 | [4] 30,300 | [4] 900 | 29,900 | 4,500 |
| 1929 | 340 | [4] 41,500 | [4] 1,100 | 40,700 | 4,350 |
| 1930 | 308 | [4] 25,300 | [4] 1,200 | 24,400 | 2,900 |
| 1931 | 373 | [4] 15,100 | [4] 700 | 14,800 | 2,070 |
| 1932 | 195 | [4] 9,400 | [4] 800 | 8,800 | 1,450 |
| 1933 | 126 | [4] 21,900 | [4] 1,000 | 21,000 | 1,650 |
| 1934 | 157 | [4] 21,000 | [4] 1,700 | 19,500 | 1,850 |
| 1935 | 160 | [4] 34,200 | [4] 1,300 | 33,100 | 1,950 |
| 1936 | 107 | [4] 47,600 | [4] 2,500 | 45,200 | 1,965 |
| 1937 | 219 | [4] 48,500 | [4] 2,800 | 45,900 | 2,400 |
| 1938 | 416 | [4] 26,200 | [4] 4,200 | 22,400 | 2,300 |

[1] No canvass.
[2] Exclusive of recoveries by International Nickel Co. from scrap nickel or alloys.
[3] Includes nickel produced from complex sulfides mined in Missouri.
[4] Nickel content estimated.

## PRODUCTION

Domestic production of nickel includes only minor quantities of secondary metal recovered from scrap-nickel anodes, nickel-silver, and copper-nickel alloys (including Monel metal) and small quantities of primary metal recovered in copper refining, as shown in the following table. Further details on the production of secondary nickel are given in the chapter on Secondary Metals.

[2] Allsman, P. T., Cost of Mining 55 Tons of Copper-Nickel Ore at the Great Eastern Prospect, Bunkerville, Clark County, Nev.: Bureau of Mines Inf. Circ. 7029, 1938, 8 pp.
[3] Hunter, C. E., and Mattocks, P. W., Nickel Deposits at Webster and Democrat, N. C.: Tennessee Valley Authority, Geol. Bull. 10, April 1938, pp. 22–26.

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*Nickel produced in the United States, 1934–38*

| Year | Primary [1] | | Secondary [2] | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| 1934 | 157 | $108,414 | 1,850 | $1,295,000 |
| 1935 | 160 | 129,500 | 1,950 | 1,365,000 |
| 1936 | 107 | (3) | 1,965 | 1,375,000 |
| 1937 | 219 | (3) | 2,400 | 1,680,000 |
| 1938 | 416 | (3) | 2,300 | 1,610,000 |

[1] Nickel content of nickel salts and metallic nickel produced as a byproduct in the electrolytic refining of copper.
[2] Nickel recovered as metal and in nonferrous alloys and salts.
[3] Bureau of Mines not at liberty to publish value.

## IMPORTS AND EXPORTS

The principal nickel imports of the United States are metallic nickel and nickel alloys, ore and matte (chiefly matte containing approximately 55 percent nickel and 25 percent copper), and nickel oxide. All the oxide, virtually all the ore and matte, and 98 percent of the metallic nickel and alloys were obtained from Canada in 1938; Europe supplied the remainder of the ore, matte, and metallic nickel and alloys. The matte is refined to Monel metal and other products at the plant of the International Nickel Co., Inc., Huntington, W. Va.

Exports consist largely of products manufactured from imported raw materials; Europe is the principal market.

*Nickel imported for consumption in the United States, 1936–38, by classes*

| Class | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Unmanufactured: | | | | | | |
| Nickel ore and matte | 23,194,329 | $3,048,966 | 25,085,947 | $3,258,221 | 14,629,473 | $1,952,396 |
| Nickel alloys, pigs, bars, etc | 80,537,245 | 20,265,293 | 81,745,023 | 20,306,471 | 43,906,331 | 11,022,673 |
| Nickel oxide | 2,550,073 | 477,285 | 2,044,395 | 385,644 | 555,181 | 94,899 |
| Manufactured: | | | | | | |
| Nickel silver or German silver in sheets, strips, rods, and wire | | | | | 296 | 219 |
| All other manufactures of nickel | (1) | 21,704 | (1) | 35,668 | (1) | 19,316 |
| | | 23,813,248 | | 23,986,004 | | 13,089,503 |

[1] Quantity not recorded.

*Nickel exported from the United States, 1936–38, by classes*

| Class | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Nickel, Monel metal, and other alloys | 6,876,594 | $3,060,339 | 7,633,189 | $2,685,305 | 11,842,937 | $2,892,423 |
| Manufactures | (1) | 3,635,430 | (1) | 2,464,518 | (1) | 606,892 |
| Nickel-chrome electric resistance wire | 328,749 | 414,542 | 494,848 | 562,693 | 490,640 | 552,470 |
| Nickel silver or German silver in bars, rods, or sheets | 950,803 | 144,176 | 818,539 | 181,037 | 794,811 | 91,290 |
| | | 7,254,487 | | 5,893,553 | | 4,143,075 |

[1] Quantity not recorded.

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## WORLD ASPECTS

*World production.*—World nickel production in 1938 may be estimated roughly at 109,000 metric tons, or about 5 percent less than in 1937 Canada decreased its output 6 percent but supplied about 88 percent of the total. The output in New Caledonia, the second largest producer, was about the same as in 1937.

*World production of nickel (content of ore), 1934–38, by countries, in metric tons*

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Brazil | 39 | 5 | 478 | 104 | (1) |
| Burma | 1,228 | 1,488 | 1,312 | 1,233 | 935 |
| Canada | 58,371 | 62,830 | 76,992 | [2] 102,015 | 95,559 |
| Egypt | | | | 14 | (1) |
| Germany | | 272 | 660 | 890 | (1) |
| Greece | 1,063 | 1,109 | 1,255 | 957 | (1) |
| Italy | | | (3) | 68 | (1) |
| Japan | | 4 | 24 | (1) | (1) |
| Morocco, French | | 208 | 85 | 132 | 163 |
| Netherland India | | | | | [4] 500 |
| New Caledonia | 8,600 | 6,300 | 4,964 | 6,096 | 6,004 |
| Norway | 1,334 | 1,235 | 1,455 | 982 | [4] 1,125 |
| Southern Rhodesia | | 12 | 14 | 2 | [4] 14 |
| Union of South Africa | | | | | 45 |
| U. S. S. R. | 863 | 1,829 | 2,000 | 2,000 | [4] 2,500 |
| United States [5] | 142 | 145 | 97 | 199 | 377 |
| | 71,600 | 75,400 | 89,300 | 115,200 | (1) |

[1] Data not yet available.
[2] Excludes small quantity produced in British Columbia.
[3] Less than 1 ton.
[4] Estimated.
[5] Byproduct in electrolytic refining of copper.

*World consumption.*—The London Mining Journal (March 4, 1939, p. 173) estimates world consumption of nickel in 1938 as follows:

| | *Metric tons* | | *Metric tons* |
|---|---|---|---|
| United States | 23,400 | Italy | 3,600 |
| U. S. S. R. | 17,300 | Sweden | 2,500 |
| United Kingdom | 13,200 | Czechoslovakia | 2,000 |
| Germany (including Austria) | 12,200 | Other countries | 3,100 |
| Japan | 9,100 | | |
| France | 6,100 | | 92,500 |

The foregoing figures indicate gains over 1937 of 1,000 tons each for Japan, France, and Italy and 500 tons each for Sweden and Germany, but losses of 17,000 tons for the United States, 1,000 tons each for the U. S. S. R. and the United Kingdom, and 500 tons for Czechoslovakia.

## REVIEW BY COUNTRIES

*Burma.*—The nickel produced in Burma is derived from a nickel-bearing speiss made by the Burma Corporation, Ltd., at Namtu in the Northern Shan States. The speiss, containing approximately 30 percent nickel, 8 percent copper, and 7 percent cobalt, as well as 17 ounces of silver to the ton, is shipped to Hamburg for further treatment.

*Canada.*—Virtually all the Canadian output is derived from the copper-nickel ores of the Sudbury district, Ontario; and two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Production in Canada was 105,337 short tons valued at $53,949,311 in 1938 compared with 112,453 tons valued at $59,507,176 in 1937.

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The International Nickel Co. of Canada, Ltd.,[4] operated at a slightly reduced scale throughout 1938. Four mines—Frood (3,497,846 tons), Creighton (1,092,155 tons), Levack (814,513 tons), and Garson (380,780 tons)—produced 5,785,294 short tons of ore. Proved ore reserves at all Canadian mines of the company were 212,368,000 tons containing 6,806,000 tons of copper and nickel on December 31, 1938, compared with 6,739,000 tons of copper and nickel in the reserves on December 31, 1937.

The concentrator treated 4,519,652 tons of ore in 1938. The Port Colborne nickel refinery produced 62,117 tons of refined nickel in 1938. Sales of nickel in all forms were 82,189 tons in 1938 (103,850 tons in 1937).

Falconbridge Nickel Mines, Ltd., [5] operated at a higher rate than in 1937 and treated 490,938 tons of ore (438,629 tons in 1937), comprising 252,866 tons of milling ore and 238,072 tons of smelting ore. The ore, which averaged 1.81 percent nickel and 0.95 percent copper in 1938, is smelted in Canada and the matte shipped to Norway for refining. Ore reserves were 6,881,000 tons averaging 1.80 percent nickel and 0.97 percent copper on December 31, 1938, compared with 6,333,000 tons containing 1.82 percent nickel and 0.89 percent copper on December 31, 1937.

*Finland.*[6]—The mine development program at Petsamo of the Petsamon Nikkeli O/Y is progressing satisfactorily. An adit 8,580 feet long, driven to reach the ore body, was completed in January 1939, and it is expected that the vertical shaft (680 feet deep) will connect with the adit early in 1939. Many of the surface buildings, such as shops, storehouses, and workmen's dwellings, have been built and construction of the smelting plant is actively under way. A hydroelectric power development is under way to provide power for the operation of the Kaulatunturi mine and the smelting plant. Barring unforeseen emergencies the mine, smelter, and hydroelectric power station will begin production by the autumn of 1940.

*Germany.*[7]—Owing to the low grade of its ore and resultant unprofitable exploitation, Germany's only nickel mine, at Frankenstein, Silesia, remained idle for many years, and its operation was revived only in 1935 and 1936, when it furnished a small output of nickel—200 and 450 metric tons, respectively. In 1937 production was 87,000 metric tons of nickel ores. Intensive exploitation during the World War reduced the nickel content of the Frankenstein deposits from 2.5 to only 1 percent, and it was only with the development of the improved "Renn" process by the Krupp Co. that a resumption of exploitation of the deposits was made practicable in 1935. Availability of the Renn process has caused interest to be revived in nickel deposits in other parts of Germany, notably those at Horbach near St. Blasien, Baden.

*Japan.*—Since Japan has been making all possible efforts to be independent of imports of nickel, reports frequently have appeared in the press of the discovery of deposits supposed to be of such richness and extent as to challenge the supremacy of the Sudbury district (Ontario), but such reports no doubt reflect wishes rather than actual discoveries.

[4] International Nickel Co. of Canada, Ltd., Annual Report, 1938.
[5] Falconbridge Nickel Mines, Ltd., 10th Annual Report, 1938.
[6] International Nickel Co. of Canada, Ltd., Annual Report, 1938.
[7] Redecker, S. B., American consul, Frankfort on the Main, Germany, May 14, 1938.

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The Nippon Nickel Co. is the only firm in Japan to refine metallic nickel from domestic ores.[8] It is reported that company prospectors recently discovered a deposit of 2 to 3 percent ores. Those currently worked contain only 0.3 to 0.88 percent nickel.

The Nippon Kogyo Kaisha is producing nickel by importing the ore from New Caledonia.

The Toho Kinzoku Seiren Kabushiki Kaisha has been organized and plans to erect a refining plant capable of producing 2,100 metric tons of nickel and 20 tons of cobalt annually. Nickel ore will be obtained from Southern Rhodesia.[9]

*Netherland India.*—It is reported [10] that the Oost-Borneo Maatschappij has shipped about 20,000 tons of nickel ore from the newly opened Celebes mines to Krupp in Germany, where the ore is to be tested for its adaptability for treatment by certain metallurgical processes.

*New Caledonia.*—Exports of crude ore (4 to 6 percent nickel content) increased to 30,810 metric tons in 1938 from 17,960 tons in 1937, but shipments of matte (about 77 percent nickel content) declined to 5,932 metric tons from 6,830 tons. Figures for 9 months indicate that Japan took nearly 55 percent and Germany 45 percent of the ore exported in 1938; a small amount went to Belgium. All the matte was shipped to France and Belgium.

*Norway.*—The Falconbridge refinery at Kristiansand operated steadily and normally throughout 1938 on matte from the Falconbridge smelter near Sudbury, Ontario, Canada, and on some custom matte. It produced 8,213 short tons of nickel (7,429 tons in 1937) and 4,125 tons of copper (3,820 tons in 1937). In 1938 sales of nickel were 7,142 tons (6,621 tons in 1937) and of copper 3,854 tons (3,115 tons in 1937).

*Southern Rhodesia.*—According to the Mining Journal: [11]

> Nickel was produced in small quantities from the Noel Nickel Mine, Gwanda. This property is now being worked by a strong mining company, and it is the intention of the company to put in a production plant with a capacity of from 200 to 300 tons of ore per day. Meanwhile, the fuller prospecting and development of the property is being pushed ahead with all speed.

*Union of South Africa.*—The new plant at Rustenburg Platinum Mines, Ltd., which began operation in 1937, produced matte containing 40 percent nickel, 25 percent copper, and 35 ounces of precious metals per ton in 1938.[12]

*U. S. S. R.*[13]—During the past 5 or 6 years Soviet geologists and mining engineers have been prospecting the Kola Peninsula, the Moncha district in particular. Deposits of iron, copper, and nickel ores, as well as occurrences of gold, platinum, cobalt, and other metals, were located. Especially interesting nickel ore deposits, said to be very rich, have been found in two localities called Nittis and Kumujie. Construction of a plant for refining this ore was started a few years ago at Monchagorsk (the town of Moncha); it was completed in October 1938 and has started to produce nickel. It can produce 2,500 tons of metal annually, provided a daily supply of 500 tons of ore is available. The present state of nickel ore mining in

[8] Mining Journal (London), vol. 203, Dec. 31, 1938, p. 1204.
[9] Warner, Gerald, American consul, Taihoku, Taiwan, Japan, Aug. 27, 1938.
[10] American Metal Market, vol. 45, Oct. 19, 1938, p. 7.
[11] Mining Journal (London), vol. 204, Mar. 4, 1939, p. 196.
[12] Metal Bulletin (London), No. 2295, June 3, 1938, p. 4.
[13] Metal Industry (London), vol. 53, Nov. 25, 1938, p. 526.

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the Nittis-Kumujie district has been disappointing, however, and instead of the 500 tons contemplated, hardly 200 tons daily are being mined.

The refinery at Ufalei, opened 4 years ago, produces some 1,500 tons of nickel per annum. A third refinery will be constructed in the South Urals district, where nickel ore deposits are considered by the Soviet experts to be of very rich nickel content.

*United Kingdom.*—The Clydach nickel refinery of the Mond Nickel Co., Ltd., produced 21,981 short tons of nickel in the form of pellets in 1938 (19,777 tons in 1937) and 1,224 tons of nickel in salts (1,215 tons in 1937).

## COBALT

Consumption of cobalt in the United States in 1938, as indicated by imports, declined substantially; and, as in the past, the demand was supplied entirely by imports, as there was no domestic output. Total imports decreased about 28 percent. Despite the decreased demand, domestic quotations were unchanged—97 to 99 percent metal from Belgium in lots of 100 pounds or more was $1.36 a pound and black oxide (70 to 71 percent grade) in lots of 350 pounds or more, $1.67 a pound.

World production may be roughly estimated at 4,500 metric tons in 1938 compared with 3,800 tons in 1937. Outputs in Burma and Canada declined moderately, but production in French Morocco and Northern Rhodesia increased substantially. A small quantity was produced in Chile in 1938.

World consumption of cobalt was estimated by the London Mining Journal (Mar. 4, 1939, p. 175) at 3,100 tons in 1938 compared with 3,000 tons in 1937.

### PRODUCTION

There was no marketed production of cobalt from domestic deposits in 1938. A western electrolytic-zinc plant recovered 16 short tons of residue containing 3.3 percent cobalt, but no shipments were made.

The United States, a large consumer of cobalt, has thus far failed to develop substantial supplies, but recent developments raise the hope that this country may yet produce cobalt in commerical quantities. Experiments on recovery of cobalt from the iron ores mined at Cornwall, Pa., were carried on during 1938. Cobalt, which has long been known to occur as a minor constituent of these iron ores, has been found in increased amounts in the ore bodies now being mined. Substantial values in cobalt, nickel, and platinum have been reported discovered associated with the molybdenite near Porthill, Boundary County, Idaho, and two flotation machines to separate these metals have been installed. In the Tombstone district, Ariz., development was continued in 1938 on a prospect from which a small quantity of ore reported to contain 1 to 7 percent cobalt was produced (but not sold) in 1937. Near Keating, Oreg., development was in progress at a deposit reported to contain cobalt and nickel.

### FOREIGN TRADE

A feature of the import trade in 1938 was the marked increase in receipts of metal from Canada and Finland and receipts of 17,783 pounds of ore from the recently reopened mines in Chile. After advancing progressively for several years, imports of cobalt dropped

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considerably in 1938. Total imports of cobalt decreased approximately 28 percent in 1938 compared with 1937. Imports of ore declined 23 percent, metal 13 percent, and oxide 56 percent. Exports of cobalt and cobalt products are not reported separately, but they are believed to be relatively unimportant.

*Cobalt ore, metal, and oxide imported for consumption in the United States, 1937–38, by countries, in pounds*

| Country | Ore | | Metal | | Oxide | |
|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 |
| Australia | 8,120 | | | | | |
| Austria | | | 154 | [1] 33 | | |
| Belgium | | | 916,749 | 617,088 | 301,000 | 22,050 |
| Canada | 579,379 | 432,201 | 8,426 | 80,779 | 90,310 | |
| Chile | | 17,783 | | | | |
| Finland | | | 147,800 | 240,575 | 109,550 | 89,250 |
| France | | | | | 74,480 | 120,540 |
| Germany | | | | [1] 1 | 267,507 | 141,375 |
| | 587,499 | 449,984 | 1,073,129 | 938,476 | 842,847 | 373,215 |

[1] Austria included with Germany, beginning May 6, 1938.

*Cobalt ore, cobalt (metal), oxide, and other compounds of cobalt imported for consumption in the United States, 1935–38*

| | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value |
| Cobalt ore | 419,110 | $46,608 | 1,039,760 | $77,965 | 587,499 | $44,352 | 449,984 | $32,354 |
| Cobalt (metal) | 563,866 | 630,289 | 883,377 | 1,014,965 | 1,073,129 | 1,341,928 | 938,476 | 1,146,559 |
| Oxide | 557,083 | 503,445 | 813,642 | 885,566 | 842,847 | 1,059,432 | 373,215 | 519,201 |
| Sulfate | 80,082 | 23,333 | 46,472 | 16,502 | 56,540 | 21,858 | 41,811 | 18,277 |
| Other salts and compounds | 472 | 679 | 186 | 277 | 45 | 187 | 56 | 98 |

## USES

Increasing world production, assurance of adequate supplies, and extensive research investigations have been important factors in expanding the use of cobalt. Cobalt oxide is used in the ceramic industry and as a catalyst; cobalt salts in the preparation of driers for use in paints, varnishes, and linoleums; and cobalt metal in various types of high-grade steels (especially metal-cutting and magnet steels), as a catalyst, and in electroplating processes.

According to the London Mining Journal (Mar. 4, 1939, p. 175) the cobalt industry maintained its position during 1938 chiefly because of the demand for the metal in the catalytic synthesis of hydrocarbons from mixtures of carbon monoxide and hydrogen, for which purpose it is extensively used in the Fischer-Tropsch reaction to give a wide range of *n*-paraffins. The metals that form the basis of active catalysts for the Fischer-Tropsch reaction are iron, nickel, and cobalt.

Special cobaltized salt for incorporation in salt licks for cattle and sheep is now being prepared in New Zealand.[14] It contains 4 ounces

[14] Bulletin of the Imperial Institute, vol. 36, London, October-December 1938, p. 511.

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of cobalt sulfate to 18¾ pounds of salt, with 1 pound of hematite added to color it bright red. This is intended to be used at the rate of 1 pound to 1 hundredweight of agricultural salt, the red color forming a guide to the completeness of the mixing.

## WORLD PRODUCTION

Lack of statistics on the production of cobalt in the Belgian Congo, one of the chief producers, and in several smaller producing countries precludes an accurate statement on total world output. Estimating the output of Belgian Congo very roughly at 1,500 metric tons in 1938, world production of 4,500 tons is indicated. Substantial increases in production were recorded in French Morocco and Northern Rhodesia, but output declined moderately in Burma and Canada.

The chief cobalt deposits of the world are described briefly in a recent article by More.[15]

*World production of cobalt, 1936–38, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | Cobalt-bearing material | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|
| | | Gross weight | Cobalt content | Gross weight | Cobalt content | Gross weight | Cobalt content |
| Belgian Congo | Cobaltiferous copper ore | (2) | 685 | (2) | 1,500 | (2) | (2) |
| Bolivia | Cobalt ore | | | 5 | (2) | (2) | (2) |
| Burma [4] | Cobaltiferous nickel speiss | [5] 4,669 | 214 | 4,389 | 298 | 3,399 | 238 |
| Canada: Ontario | Cobalt, alloys, and chemicals | (2) | 403 | (2) | 230 | (2) | 208 |
| Morocco, French | Cobalt ore [6] | 3,370 | 371 | 5,280 | 581 | 6,540 | 719 |
| Northern Rhodesia | Cobaltiferous copper ore | (2) | 461 | (2) | 884 | (2) | 1,461 |

[1] In addition to the countries listed, Chile, China, Finland, Germany, Japan, and Mexico produce cobalt, but production data are not available.
[2] Data not available.
[3] Less than 1 ton.
[4] Year ended June 30 of year stated.
[5] In addition, 5 tons of cobalt ore containing 14.4 percent cobalt and 5 tons of speiss containing 22.13 percent cobalt were reported from Nepal during the calendar year.
[6] Average cobalt content estimated at 11 percent.

*Belgian Congo.*—The Belgian Congo is one of the largest sources of cobalt, but accurate details of production are not available. The copper ores that contain cobalt are divided into two classes. One type, containing about 4 percent cobalt and 18 percent copper and iron, is treated in a water-jacketed furnace and an electric furnace to give a ternary alloy containing 30 percent cobalt, 40 percent iron, and 26 percent copper. The other class of ore is rich in cobalt and is sent directly to the electric furnace to obtain the same type of product.

Production of cobalt by the Union Minière du Haut Katanga was 1,500 metric tons in 1937 compared with 685 tons in 1936.[16] The cobalt-producing capacity of Union Minière du Haut Katanga has been increased considerably by the discovery of further reserves of rich cobalt minerals.[17] A fourth electric furnace for the treatment of cobaltiferous minerals has been installed at the Jabotville-Panda works.

[15] More, Ch., Le Cobalt: Minerais et sources naturelles. (Cobalt: Ores and Natural Sources): Mines, Carrières, vol. 17, Paris, June 1938, pp. 1–4; July 1938, pp. 5, 7.
[16] South African Mining and Engineering Journal, vol. 49, pt. 1, May 28, 1938, p. 427.
[17] South African Mining and Engineering Journal, vol. 49, pt. 1, Sept. 17, 1938, p. 72.

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*Burma.*—Cobalt production of Burma is derived largely as a by-product of lead-zinc mining at the Bawdwin mines of the Burma Corporation, Ltd. A nickel speiss obtained at the lead smelter contains about 7 percent cobalt. It is shipped to Hamburg for treatment.

*Canada.*—Canadian production of cobalt includes the cobalt in ores and concentrates exported from northern Ontario, cobalt metal produced by the Deloro Smelting & Refining Co., Ltd., Deloro, Ontario, and the cobalt contained in cobalt oxide produced by the same company. The total output amounted to 459,060 pounds valued at $788,576 in 1938 compared with 507,064 pounds valued at $848,145 in 1937.[18] Exports of cobalt alloys, metal, oxides, and ores were valued at $765,580 in 1938 compared with $909,140 in 1937.

Increased amounts of cobalt and nickel minerals have been reported found on the lower mine levels at Great Bear Lake, Northwest Territories.[19]

*Chile.*—A small production of cobalt was reported in Chile in 1938. According to Faust: [20]

> During the period between 1899 and 1906, three small mines, known as Rosa Amelia, Blanca, and Despreciada, near Puerto del Huasco in the Province of Atacama, produced 905 metric tons of hand-picked cobalt ore averaging 6.37 percent cobalt. About 18 months ago, the Compañia Minera "La Cobaltera" began to reopen the mines. The company expects to make its first shipment in June, the shipment to consist of 14 to 18 tons of hand-picked mineral containing approximately 12 percent of sulfarsenide of cobalt (cobaltite, CoAsS).
>
> Various pockets of ore containing up to 18 percent cobaltite have been opened, but the average material as it comes from the mine contains approximately 1.75 percent cobalt and 0.30 percent nickel. The company expects to concentrate 20 tons of this ore by the gravimetric method to obtain approximately 3 tons of 15 percent material daily. The flotation method will be adopted at a later date.
>
> There are at present three shafts—118, 49, and 47 meters deep. Sixty-eight workmen are now employed, and it is understood that this force will be increased in the near future.

*Finland.*—Finland became a producer of cobalt recently, but figures on output are lacking. Imports of cobalt metal into the United States from Finland increased to 240,575 pounds in 1938 compared with 147,800 in 1937.

In the Outokumpu copper mine, in eastern Finland, approximately 0.2 percent cobalt, 0.1 percent nickel, and 26 percent iron are associated with a 4-percent copper ore.[21] Prior to 1936 the copper concentrates were exported, but they are now sent to the smelter erected at Imatra in southern Finland.

*Germany.*—Output of cobalt in Germany will be increased by the resumption of operations of an old mine at Schneeberg, Saxony, formerly an important cobalt producer, as well as by exploitation of cobalt deposits in Wittichen and in the southern Black Forest, according to a report submitted by the American consulate general at Frankfort on the Main under date of May 14, 1938. In recent years Germany's production of cobalt, amounting to about 17 metric tons annually, was obtained as a byproduct of the Mansfeld copper shale deposits in Central Germany, but with the now developing exploitation of these cobalt deposits, output will suffice to supply the great bulk of Germany's requirements of around 100 metric tons a year.

[18] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada during the Calendar Year 1938: Ottawa, 1939.
[19] Mining Journal (London), vol. 203, Aug. 13, 1938, p. 774.
[20] Faust, J. B., American consulate general, Santiago, Chile, May 27, 1938.
[21] Mäkinen, Eero, Outokumpu Copper Mine and Smelter, Finland: Min. and Met., vol. 19, February 1938, pp. 85-91.

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*Morocco, French.*—Cobalt made its first appearance in the mineral statistics of French Morocco in 1932, when 63 metric tons were recovered. Since that time production has advanced almost steadily and reached a peak of 719 metric tons in 1938.

*Northern Rhodesia.*—The Rhokana Corporation, Ltd., sold 831 short tons of cobalt in alloys and refined products during the year ended June 30, 1938, compared with 730 tons during the corresponding year 1937. Production increased to 1,461 metric tons in the calendar year 1938 compared with 884 tons in 1937. A third electric furnace, increasing capacity for treating converter slags by 50 percent, was added to the cobalt plant. A plant for the differential flotation of copper and cobalt to obtain a rich cobalt concentrate has also been installed.

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# MOLYBDENUM, TUNGSTEN, AND VANADIUM

By Robert H. Ridgway and H. W. Davis [1]

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## MOLYBDENUM

The output of molybdenum, unlike that of most other industrial metals, increased in 1938, thereby continuing its remarkable progress. Although record production figures were established, consumption was not as high as in 1937, when record steel output plus extensive armament activities pressed production facilities to meet demand. In consequence, some stocks accumulated at mines during 1938. In this country, the predominant producer, output of molybdenum in the form of concentrates exceeded shipments by 7,500,000 pounds—an amount equivalent to about 30 percent of the total shipments. Stocks at the beginning of 1938, however, were small.

Of the record world output of 36,000,000 pounds of molybdenum in 1938, the United States supplied 33,297,000 pounds (92.5 percent); thus, the United States furnishes the bulk of the world's molybdenum. The relatively small amount produced by other countries came mainly from Mexico and Norway; output in Mexico was less in 1938 than in 1937, but production in Norway increased. Molybdenum is one of the few ferro-alloying elements of which this country has ample supplies for its own needs.

Exports of molybdenum from the United States are not known exactly, since they are not classified separately in trade statistics, but they are believed to comprise 50 to 75 percent of the domestic production.

The Climax mine of the Climax Molybdenum Co. is the principal producer of molybdenum, having furnished about 78 percent of the world output and 85 percent of the domestic output in 1938. New capacity added in 1937 permitted 12,000 short tons of ore to be milled per day in 1938. Output of molybdenite concentrates from the copper ores of the Utah Copper Co. at Bingham, Utah, and of

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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the Nevada Consolidated Copper Corporation at Chino, N. Mex., continued during the year. As this output is entirely byproduct and depends on the rate of copper operation, production dropped in 1938. Of interest during the year were the initial production and shipment of molybdenite concentrates from the copper operations of the Miami Copper Co., Miami, Ariz.

Activities in the search for and development of molybdenum deposits in various parts of the world continued in 1938.

*Salient statistics of the molybdenum industry in the United States, 1936–38* [1]

| | 1936 | 1937 | 1938 |
|---|---|---|---|
| Production: | | | |
| Ore, short tons | 2,269,000 | [2] 3,638,000 | [3] 4,601,000 |
| Concentrates, do | 17,686 | 30,357 | 36,157 |
| Molybdenum contained: | | | |
| Average, percent | 48.59 | 48.46 | 46.05 |
| Total, pounds | 17,186,000 | 29,419,000 | 33,297,000 |
| Shipments (molybdenum contained): | | | |
| Pounds | 17,959,000 | 30,122,000 | 25,727,000 |
| Value [2] | $11,933,000 | $20,571,000 | $17,977,000 |
| Imports (molybdenum contained): | | | |
| Pounds | 49 | 7,707 | 25 |
| Value | $213 | $13,491 | $81 |

[1] Figures for molybdenum exported not separately recorded.
[2] Excludes copper ore yielding molybdenite concentrates from New Mexico and Utah in 1937 and Arizona, New Mexico, and Utah in 1938.
[3] Estimated by Bureau of Mines.

## PRICES

Prices for molybdenite concentrates carrying 90 percent $MoS_2$ were quoted nominally by the Engineering and Mining Journal at 42 cents per pound of contained $MoS_2$ from January 1, 1938, until late in March, when the quotation rose to 45 cents where it remained for the rest of the year; however, London prices for the same grade of concentrates decreased during the year. In January 1938 the quotations were 47s. per long ton unit. Lower quotations reduced the figure to 41–42s. late in December. This price drop was equivalent to a decrease from 52 cents per pound in January to 43 cents in October.

## DOMESTIC PRODUCTION

*Alaska.*—The Kennecott Copper Corporation abandoned its development work on the molybdenum prospect near Valdez in the Copper River Valley during 1938.

*Arizona.*—Five mines in Arizona produced 4,784 short tons of concentrates containing 1,139,593 pounds of molybdenum in 1938.

The largest producer, the Arizona Molybdenum Corporation, which operates a property near Mammoth, Pinal County, treated 79,333 short tons of ore during 1938, from which 537 tons of concentrates containing 607,605 pounds of molybdenum were recovered. The mine was shut down late in the year, but the mill continued to operate on the tailings supply. The reopening of the mine will depend on results of further exploration and development.

The Molybdenum Gold Mining Co., a subsidiary of the Molybdenum Corporation of America, continued to mine complex ore from the oxide zone in the Mohawk and New Year claims near Mammoth. The mine-run ore goes to the nearby mill of the Mammoth-St. Anthony, Ltd., where gold, silver, lead, molybdenum, and vanadium are

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recovered by selective flotation. The latter company also treats a similar ore from its nearby Mammoth mine. In 1938, the mill produced 4,191 short tons of concentrates containing 481,156 pounds of Mo. The geology and ore deposits of this area have been described by Peterson.[2]

The Miami Copper Co. reported the recovery and shipment in 1938 of a small quantity of molybdenite concentrates resulting from the re-treatment of copper sulfide concentrates at Miami, Gila County.

*Colorado.*—The Climax Molybdenum Co., the world's largest producer of molybdenum, operated its mine and mill at capacity throughout 1938, having mined 4,344,734 short tons of ore containing 0.606 percent $MoS_2$ from which 27,591 short tons of concentrates containing 28,242,085 pounds of molybdenum were recovered. Production exceeded shipments, permitting some stock of concentrates to be built at the mine. Output at this property has increased nearly six times during the past 6 years, as shown in the following table.

*Molybdenum (element) contained in concentrates produced from the Climax deposit, Colorado, 1933–38*

| | Pounds | | Pounds |
|---|---|---|---|
| 1933 | 5, 028, 695 | 1936 | 15, 216, 806 |
| 1934 | 8, 378, 683 | 1937 | 22, 750, 368 |
| 1935 | 10, 168, 635 | 1938 | 28, 242, 085 |

The building program, which included mill enlargement, hotel, hospital, houses for employees, street work, and sewer and water-pipe installation, was completed early in 1938.[3]

Other development work and discoveries were reported from Colorado in 1938, but Climax was the only producer.

*Idaho.*—The International Molybdenum Co. made a small production, but no shipments, in connection with the development of its property near Porthill in Boundary County. Additional flotation equipment was installed in 1938. The ore at this property also contains values in nickel, cobalt, and platinum.

*Nevada.*—No production or shipment of molybdenum was recorded for Nevada in 1938, but development work on several deposits was reported.

*New Mexico.*—The Molybdenum Corporation of America continued to operate its mine and mill some 7 miles east of Questa along the Red River. The ore is relatively high grade and the tonnage treated comparatively low. Development work on lower levels is reported to be giving encouraging results. The geology and ore deposit have been described by Vanderwilt.[4]

Molybdenite concentrates also were produced by the Nevada Consolidated Copper Corporation at the Chino property in the treatment of copper ores.

*Utah.*—All production in 1938 came from the Utah Copper Co., where molybdenite is recovered as a byproduct in the concentration of copper ores and re-treatment of molybdenum-bearing concentrates. As the molybdenum content of the ore is very low the molybdenite

[2] Peterson, N. P., Geology and Ore Deposits of the Mammoth Mining Camp Area, Pinal County, Ariz.: University of Arizona, Arizona Bureau of Mines Bull., vol. 9, No. 2, April 1, 1938, pp. 1–63.

[3] Richardson, J. K., A Modern Hospital Serves Climax Camp: Eng. and Min. Jour., vol. 139, No. 11, November 1938, pp. 36–38.

[4] Vanderwilt, J. W., Geology of the "Questa" Molybdenite Deposit, Taos County, N. Mex.: Proc. Colorado Sci. Soc., vol. 13, No. 11, 1938, pp. 599–643.

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concentrates produced are entirely byproduct and fluctuate with the output of copper, thus output was lower in 1938 than in 1937. A material improvement in recoveries, however, explained in large degree the smaller proportionate decline in the production of molybdenite compared with copper.

*Washington.*—The Deertrail Monitor Mines Co. mined about 3,000 short tons of ore at its Monitor mine on Adams Mountain 6 miles east of Fruitland, Stevens County. About 300 tons were milled in the 50-ton flotation mill, from which 3 tons of concentrates were recovered; 5 tons were shipped. Three other concerns—the Copper Mining Co., the Consolidated Mines & Smelting Co., Ltd., and the American Rand Corporation—produced ore in connection with development operations, but the ore was not concentrated, and there were no shipments.

## IMPORTS AND EXPORTS

Exports of molybdenum, principally in the form of concentrates, provide an important outlet for the domestic molybdenum industry. Data are not available, since molybdenum is not classified separately in export statistics; but it appears that 50 to 75 percent of the domestic production is exported. Imports of molybdenum or molybdenum compounds are small.

*Molybdenum ore and concentrates, ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum imported for consumption in the United States, 1934–38*

| Year | Molybdenum content (pounds) | Value | Year | Molybdenum content (pounds) | Value |
|---|---|---|---|---|---|
| 1934 | 213,928 | $124,156 | 1937 | 7,707 | $13,491 |
| 1935 | 68,758 | 40,721 | 1938 | 25 | 81 |
| 1936 | 49 | 213 | | | |

In addition to the quantity shown in the above table 139,535 pounds of ore and concentrates containing 91,905 pounds of molybdenum valued at $41,586 were imported for smelting, refining, and export in 1938 compared with none in 1937. Of the 1938 figure 136,200 pounds containing 90,442 pounds of Mo valued at $40,780 came from Turkey.

## USES

Molybdenum is used principally in the iron and steel industry for making special alloy steels. Continued research is broadening the field of application both in new outlets and as a substitute for and an addition to other alloying elements. Molybdenum may be used alone to impart certain desired properties to iron and steel, but more frequently it is used with one or more of the other ferro-alloying elements.

For most purposes molybdenite ($MoS_2$), the principal mineral raw material, is converted, before using, to ferromolybdenum (a product carrying 60 to 65 percent molybdenum) or to calcium molybdate (a compound resulting from the roasting of molybdenite with lime and containing 35 to 45 percent molybdenum). The latter is the cheaper method of preparing molybdenum for industrial applications. Molyb-

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denum oxide in briquets is also used in making molybdenum additions to iron and steel.

Improved processes of heat-treating and fabricating high-speed tool steels, in which part of the tungsten has been replaced by molybdenum, have increased the use of molybdenum in this field. Molybdenum is also being employed more generally in stainless steels of the 18–8 type.

Molybdenum compounds find limited use in nonmetallics, but consumption is not large.

## WORLD PRODUCTION

World production of molybdenum comes from only a few mines. Operations in Mexico, Norway, and the United States furnish the bulk of the world requirements. The search for new sources continued during 1938; but, so far as is known, there were no significant developments.

*World production of molybdenum ores and concentrates, 1934–38, in metric tons*

[Compiled by M. T. Latus]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia: | | | | | |
| New South Wales (concentrates) | 3 | | [1] | 16 | [2] |
| Queensland (concentrates) | 1 | 11 | 20 | 23 | 14 |
| Victoria (concentrates) | | | | 31 | 36 |
| Burma | | | | [1] | [2] |
| Canada (concentrates) | | | | 7 | |
| China (ore containing 45 percent Mo) | 2 | [2] | [2] | [2] | [2] |
| Chosen (ore) | 104 | 106 | 80 | [2] | [2] |
| Italy (ore) | | | 861 | 46 | [2] |
| Japan (dressed ore) | 5 | 6 | 7 | [2] | [2] |
| Mexico (Mo content) | 467 | 687 | 534 | 629 | 483 |
| Morocco, French (concentrates) [3] | 149 | 190 | 187 | 195 | 258 |
| Norway (Mo content) | 146 | 388 | 422 | 344 | 450 |
| Peru (concentrates) | 15 | 13 | 19 | 83 | 153 |
| Rumania (Bi-Mo ore) | 6 | 14 | 46 | 27 | [2] |
| Turkey (ore) | | | | 43 | [2] |
| United States (Mo content) | 4,247 | 5,222 | 7,795 | 13,344 | 15,103 |
| Yugoslavia | | 18 | | 84 | 19 |

[1] Less than 1 ton.
[2] Data not available.
[3] Exports.

*Canada.*—In 1938 the Zenith Molybdenite Corporation, formerly the Phoenix Molybdenite Corporation, Ltd., Renfrew County, Ontario, reported shipment to England and France of 7 metric tons of concentrates valued at $4,500; these had been produced in 1937. Prospectors have been active recently both in prospecting and developing molybdenite properties in Ontario.

*Mexico.*—Output, which was lower in 1938 than in 1937, comes principally from the Greene Cananea Copper Co., where molybdenite concentrates are recovered as a byproduct in the treatment of copper ores. Mine and reduction works at Cananea were closed by a strike during the latter half of September; then a 2-year labor contract was signed.

*Morocco, French.*—French Morocco is the largest producer in Africa. Much of the output comes from the mine of the Société le Molybdène near Azegour. A discovery of deposits in the Haut-Tifnout region near the Souss valley recently has been reported.[5]

[5] Metal Bulletin (London), The Tifnout Deposits: No. 2369, February 24, 1939, p. 16.

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*Norway.*—The Knaben Mölybdan Gruber was the only producer in Norway in 1938. Output was larger than in 1937. A concentrating plant was being installed at the Laxadalen Molybdängruber at Gildeskal, northern Norway, but no output has yet been recorded.

*Turkey.*—Production of molybdenum in Turkey is small, but shipments were made to the United States in 1938.

## TUNGSTEN

Interest in the tungsten industry in 1938 continued to be centered chiefly on conditions in China, the principal source, but the effect of hostilities was not as pronounced as in 1937. Japanese gains in 1938 did not give them control of the tungsten-producing areas; but the railroad through South China to Canton and Hongkong, the main route of flow after the capture of Shanghai in 1937, fell to the invaders late in 1938. Tungsten concentrates in reduced quantities continued to move out, however, principally through Swatow, and this movement together with supplies available from other sources and lessened demand eased the tungsten situation in 1938.

Apparently the United States was the second largest producer in 1938, and domestic output was the highest of any before and since the war years 1916–18, when exorbitant prices and shortage of supplies stimulated a country-wide search for strategic minerals. Although production from domestic mines increased over 1937, shipments declined, resulting in some stock at mines or mills. The development and reequipment of properties continued in the Western States, and activities around Bishop, Calif., attracted attention during 1938. As the year progressed, however, there was some curtailment in the domestic industry.

*Salient statistics of the tungsten industry in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Production (60 percent $WO_3$) | 3,500 | (1) | 4,000 | (1) |
| Concentrates shipped (60 percent $WO_3$) | 3,500 | $4,094,000 | 3,044 | $3,161,498 |
| Imported for consumption (W content) | 2,848 | 3,073,612 | 81 | 138,693 |
| Stocks in bonded warehouses, Dec. 31: | | | | |
| Ore (W content) | 401 | 707,350 | 326 | 602,376 |
| Metal (W content) | 4 | 9,447 | 10 | 24,182 |

[1] Figures not available.

*Strategic reserve.*—Tungsten is listed as a strategic commodity, but the position of the United States with regard to this essential metal is far less vulnerable than that with respect to manganese, tin, or chromium. Under the tariff the industry has continued, and this protection together with the high world prices maintained in recent years have resulted in a large measure of self-sufficiency. No purchases for strategic stock-pile purposes have been made by the Navy Department in connection with its limited program during the last 2 years. The tungsten situation, however, is being studied thoroughly in connection with probable purchases should appropriations in legislation now pending become available. The following tables present the historical background for consideration of the strategic nature of tungsten.

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*Domestic shipments, imports, exports, and apparent consumption of tungsten in the United States, 1910–38, in thousands of pounds of metal*

| Year | Shipments | Imports [1] | Exports [1] | Apparent consumption | Year | Shipments | Imports [1] | Exports [1] | Apparent consumption |
|---|---|---|---|---|---|---|---|---|---|
| 1910 | 1,733 | 1,941 | 89 | 3,585 | 1925 | 1,133 | 1,694 | 10 | 2,817 |
| 1911 | 1,084 | 446 | [2] | 1,530 | 1926 | 1,315 | 2,884 | 24 | 4,175 |
| 1912 | 1,266 | 1,542 | [2] | 2,808 | 1927 | 1,108 | 2,198 | 16 | 3,290 |
| 1913 | 1,463 | 2,047 | [2] | 3,510 | 1928 | 1,150 | 2,969 | 13 | 4,106 |
| 1914 | 942 | 775 | [2] | 1,717 | 1929 | 790 | 6,446 | 82 | 7,154 |
| 1915 | 2,219 | 1,848 | [2] | 4,067 | 1930 | 668 | 3,998 | 24 | 4,642 |
| 1916 | 5,637 | 4,304 | 615 | 9,326 | 1931 | 1,336 | 189 | 846 | 679 |
| 1917 | 5,847 | 5,054 | 2,489 | 8,412 | 1932 | 377 | 106 | 113 | 370 |
| 1918 | 4,817 | 12,233 | 1,319 | 15,731 | 1933 | 852 | 379 | 683 | 548 |
| 1919 | 311 | 10,388 | 41 | 10,658 | 1934 | 1,950 | 954 | 563 | 2,341 |
| 1920 | 206 | 4,203 | 5 | 4,404 | 1935 | 2,279 | 892 | 798 | 2,373 |
| 1921 | ---- | 2,257 | ---- | 2,257 | 1936 | 2,486 | 3,767 | [3] 104 | 6,149 |
| 1922 | ---- | 2,908 | 1 | 2,907 | 1937 | 3,331 | 5,696 | [2] | 9,027 |
| 1923 | 229 | 79 | 4 | 304 | 1938 | 2,897 | 162 | [2] | 3,059 |
| 1924 | 538 | 142 | 3 | 677 | | | | | |

[1] Partly estimated.
[2] Figures not available.
[3] Complete data not available.

*Concentrated tungsten ores (reduced to equivalent of 60 percent of tungsten trioxide), produced in the United States, sold in 1910–38, by States, in short tons*

| Year | Arizona | California | Colorado | Idaho | Nevada | South Dakota | Washington | Other States [1] | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1910 | 17 | 480 | 1,221 | ---- | ---- | [4] | 103 | ---- | 1,821 |
| 1911 | 50 | 314 | 730 | 22 | 22 | ---- | 1 | ---- | 1,139 |
| 1912 | 27 | 462 | 812 | 20 | 8 | ---- | ---- | 1 | 1,330 |
| 1913 | 16 | 541 | 953 | 14 | 3 | 1 | 1 | 8 | 1,537 |
| 1914 | 15 | 489 | 467 | 9 | ---- | ---- | ---- | 10 | 990 |
| 1915 | 127 | 962 | 963 | 32 | 55 | 140 | 1 | 52 | 2,332 |
| 1916 | 218 | 2,171 | 2,401 | 101 | 689 | 239 | 11 | 93 | 5,923 |
| 1917 | 150 | 2,781 | 2,707 | 2 | 143 | 270 | 10 | 81 | 6,144 |
| 1918 | 213 | 1,791 | 1,910 | ---- | 898 | 201 | 1 | 47 | 5,061 |
| 1919 | 50 | 147 | 130 | ---- | ---- | ---- | ---- | ---- | 327 |
| 1920 | ---- | ---- | 216 | ---- | ---- | ---- | ---- | ---- | 216 |
| 1921 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 1922 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 1923 | ---- | ---- | 241 | ---- | ---- | ---- | ---- | ---- | 241 |
| 1924 | ---- | 219 | 123 | ---- | 117 | 106 | ---- | ---- | 565 |
| 1925 | 9 | 574 | 201 | ---- | 407 | ---- | ---- | ---- | 1,191 |
| 1926 | 25 | 490 | 232 | ---- | 545 | 90 | ---- | ---- | 1,382 |
| 1927 | 2 | 307 | 332 | ---- | 372 | 141 | ---- | 10 | 1,164 |
| 1928 | ---- | [3] | 229 | ---- | 551 | [3] | ---- | 428 | 1,208 |
| 1929 | 20 | [3] | 152 | ---- | [2] | 5 | ---- | 653 | 830 |
| 1930 | 1 | [3] | 47 | ---- | [3] | ---- | [3] | 654 | 702 |
| 1931 | 98 | [3] | 98 | ---- | [3] | ---- | [3] | 1,208 | 1,404 |
| 1932 | 62 | [3] | ---- | ---- | 241 | ---- | [3] | 93 | 396 |
| 1933 | 42 | 174 | 86 | ---- | 550 | ---- | 43 | ---- | 895 |
| 1934 | [3] | [3] | 342 | 1 | 1,044 | ---- | 164 | 498 | 2,049 |
| 1935 | 394 | [3] | 390 | ---- | 1,219 | ---- | 192 | 200 | 2,395 |
| 1936 | 489 | [3] | 180 | 11 | 1,631 | ---- | 48 | 253 | 2,612 |
| 1937 | 349 | 577 | 219 | 99 | 2,153 | ---- | 64 | 39 | 3,500 |
| 1938 | 37 | 839 | 240 | 154 | 1,461 | ---- | 303 | 10 | 3,044 |

[1] Alaska, Connecticut, Missouri, Montana, New Mexico, Oregon, and Utah, and States indicated by "3".
[2] Less than 1 ton.
[3] Bureau of Mines not at liberty to publish figures.

The following information regarding domestic sources is quoted from a Report upon Certain Deficient Strategic Minerals by the staffs of the Geological Survey and the Bureau of Mines.

*Sources.*—Most tungsten deposits are tabular bodies that either persist downward to great depths in the earth (veins) or are localized and nearly horizontal (replaced beds). Two minerals, scheelite (containing 63.9 percent tungsten) and wolframite (containing 60.7 percent tungsten) are the source of almost all tungsten. Only a few ores treated to recover tungsten yield other metals, so that tungsten is rarely a byproduct.

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Tungsten minerals are rather widespread in the United States, but most of the attempts at commercial production are confined to 11 Western States, and 3 (Nevada, California, and Colorado) currently yield more than 90 percent of the production. As the prices offered for tungsten ores have fluctuated more widely than those for the other strategic metals, the yield from the several districts, as well as the total for the United States, has also fluctuated widely. There can be hardly any doubt that some deposits have become exhausted at depths that range from 500 to 1,000 feet, and that elsewhere, even though the tungsten mineral persists, costs of production have increased.

Since 1900 the United States has imported some tungsten in the form of ore or alloys each year, and even though production has nearly equaled or even exceeded apparent consumption during a few years, dependence on foreign sources has tended to increase. A tariff was first imposed in 1909, and the latest act of 1930 provides for 50 cents per pound on the tungsten in ore and concentrate and as much as 60 cents per pound plus 50 percent ad valorem on metallic tungsten. This is higher than at any previous time. Most of the imported tungsten is in the form of ore or concentrate, and 80 percent or more is derived from China, which is the principal world source. During the past 5 years (1933–37) domestic production has been about half of the apparent consumption.

*Production from domestic mines.*—Since 1926, production of tungsten in Nevada has exceeded that of any other State, and one mine, discovered in 1917, is now the principal source in the United States. This mine derives its ore from an altered bed of limestone which contains about 1¼ percent of disseminated scheelite. This type deposit is now known to exist widely in western Nevada and southeastern California, and it is probable that other important deposits of similar nature will be found. Although mine operations rarely explore such deposits far in advance of mining and definite figures can rarely be assigned to reserves, the number and widespread distribution of the deposits seem to assure current production for a decade or more.

Numerous tungsten deposits have been explored in California, but one mine (Atolia), near Randsburg, now mining 1,400 feet below the surface, has yielded from 60 to 95 percent of the tungsten output of the State since 1909. Nearby placers have yielded considerable concentrate also. Promising, but low-grade, deposits have been extensively explored near Bishop and elsewhere.

Tungsten-bearing veins have been explored in several parts of Colorado, but a few mines in a single district (Nederland, Boulder County) have yielded nearly all of the output from the State. One mine has attained a depth of approximately 900 feet, but most of the product has been mined within 500 feet of the surface, because veins are narrow and costs increase rapidly with depth.

Even though many tungsten deposits have been explored in the eight other western States, as well as in Missouri and Connecticut, existing records indicate that shipments can be made only during times of high prices.

## PRICES

The quotations on tungsten ore or concentrates continued the decline that began in the last quarter of 1937. The low point was reached in May, after which there was some recovery, but the market was weak for the rest of 1938. The fear of stoppage of concentrates from China due to Japanese control over the routes of transportation was a bullish factor, but apparently this was counteracted by availability of supplies from other sources and by reduced demand. London prices for Chinese wolframite concentrates containing 65 percent $WO_3$, as given by the Mining Journal (London), were highest at the beginning of the year, when the quotation was 78s.–80s. The quotations declined steadily until May, when the average for the month was 37s. 1d. Subsequently the quotation rose until the last quarter, when there were minor fluctuations. The average quotation for December was 54s. 5½d. According to the Engineering and Mining Journal domestic scheelite quotations, f. o. b. New York, for concentrates containing 65 to 70 percent $WO_3$, followed somewhat the same pattern, opening the year at $22–$25 per short-ton unit

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declining to $16–$20 in May, with the closing quotation at $20. The quantity of concentrates shipped from China on barter arrangements was not without effect on the tungsten quotations.

## DOMESTIC PRODUCTION

Higher prices in 1937 and early 1938 stimulated activities in the domestic tungsten industry, particularly in California, but lower prices later in the year curtailed operations, and a number of properties closed. Although production of concentrates increased shipments declined, resulting in accumulation of some stocks at the mills. Output—the highest recorded in peacetime—came from a rather large number of widely scattered locations, and shipments were made from nine States (Arizona, California, Colorado, Idaho, Missouri, Nevada, New Mexico, Utah, and Washington). Developments in the domestic tungsten-producing industry in recent years are tending to make the United States more nearly self-sufficient in this strategic mineral commodity at prices that have maintained. This situation, however, depends on tariff, which at present amounts to $7.931 per short-ton unit of $WO_3$ on ore and concentrates.

*Concentrated tungsten ores (reduced to equivalent of 60 percent $WO_3$) produced in the United States, sold in 1934–38, and average price per unit*

| Year | Short tons | Value | Average price per unit | Year | Short tons | Value | Average price per unit |
|---|---|---|---|---|---|---|---|
| 1934 | 2,049 | $1,791,316 | $14.57 | 1937 | 3,500 | $4,094,000 | $19.50 |
| 1935 | 2,395 | 1,921,017 | 13.37 | 1938 | 3,044 | 3,161,498 | 17.31 |
| 1936 | 2,612 | 2,323,818 | 14.83 | | | | |

Gravity concentration generally is used in beneficiating tungsten ores. In crushing ore for concentration there is considerable pulverization of friable scheelite, which results in abnormal losses in the slimes. The use of flotation for the recovery of scheelite from slimed material has been investigated by the Bureau of Mines.[6] Ultraviolet lamps for detecting scheelite by fluorescence have aided the prospector, miner, and millman engaged in the search for and reduction of tungsten ores carrying it. The use of this equipment has been described by Heizer.[7]

*Arizona.*—Shipments of tungsten concentrates from Arizona operations totaled only 35 short tons containing 63.09 percent $WO_3$ in 1938 compared with 312 tons averaging 67.15 percent $WO_3$ in 1937. Output comprised scheelite, wolframite, huebnerite, and ferberite concentrates and came from scattering small operations in Cochise, Gila, Mohave, Pima, and Yavapai Counties. The mill at the Boriana mine near Yucca, Mohave County, destroyed by fire in November 1937, was rebuilt but not operated in 1938.

*California.*—Shipments of tungsten concentrates (all scheelite) from California amounted to 770 short tons containing 65.44 percent $WO_3$ in 1938 compared with 511 tons containing 67.68 percent $WO_3$

[6] Leaver, E. S. and Royer, M. B., Flotation for Recovery of Scheelite from Slimed Material: Bureau of Mines Tech. Paper 585, 1938, pp. 1–24.

[7] Heizer, Ott F., Use of Ultraviolet Light in Prospecting for Scheelite: California Jour. Mines and Geol., State Mineralogist's Report 34, vol. 34, No. 3, July 1938, pp. 331–333.

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in 1937. The largest producer, the Atolia Mining Co. near Atolia in San Bernardino County, shipped 339 tons containing 59.71 percent $WO_3$. The company milled 13,289 tons of ore containing 1.82 percent $WO_3$. Sixteen other producers—8 in San Bernardino County, 5 in Inyo, and 1 each in Kern, Mono, and Tulare Counties—contributed to the California total. The increased number of producers—17 in 1938 compared with 8 in 1937—attest to the increased interest in tungsten in California, but as prices dropped later in 1938 a number of operations were closed. Activities in recent years in the region around Bishop have resulted in some significant developments that may serve further to increase domestic output.

*Colorado.*—Output of tungsten in Colorado was higher in 1938 than in 1937. Total shipments were 360 short tons of concentrates averaging 40.05 percent $WO_3$. Most of the output was ferberite from Boulder County, but there were small shipments of huebnerite from gold-mining operations in San Juan County. The principal shipments came from the mill of the Gold, Silver & Tungsten, Inc., at Tungsten, Boulder County. The other large producer (the mine of the Wolf Tongue Mining Co. near Nederland) was idle for 9 months but is planning extensive underground development work in 1939. The mill treated 871 short tons of ore containing 2.8 percent $WO_3$. A 50-ton concentration mill was built at the Conger mine in 1938 by the Vanadium Corporation of America.

*Idaho.*—The Ima mine on Patterson Creek about 11 miles east of May operated during the last 10 months of 1938. The mill was enlarged to 150 tons capacity; 26,823 short tons of ore containing 0.5 percent $WO_3$ were milled, yielding 139 short tons of huebnerite concentrates averaging 66.54 percent $WO_3$. The mill also makes a sulfide concentrate carrying silver, copper, lead, and zinc.

*Missouri.*—A small shipment (less than 1 ton) of high-grade concentrates was reported from Missouri in 1938. The hand-picked ore came from the dump of the old Silver mine 10 miles west of Fredericktown, Madison County.

*Nevada.*—Nevada retained its position as the principal tungsten producer in 1938; shipments of concentrates totaled 1,461 short tons reduced to equivalent 60 percent $WO_3$. A large part of the output was scheelite concentrates from mines of the Nevada-Massachusetts Co. near Mill City and Mina. The company has sunk the Humboldt and Stank shafts to the 1,350 level and is reopening and developing the Sutton ore body. The new mill operating on tailings is working successfully, and a good grade of concentrate (70 percent $WO_3$) is being produced. The Tungsten Metals Corporation at Ely, White Pine County, produced from three mines and was the largest of several other small operators that contributed to the Nevada total in 1938.

Development work continued, and new equipment was installed at the Oreana mine in Pershing County by the Rare Metals Corporation. The Oreana tungsten deposit is unique among American tungsten deposits in that the scheelite mineralization is considered pegmatitic.[8] An addition to the mill at the Nightingale mine 50 miles west of Lovelock, Pershing County, was installed in 1938.

[8] Kerr, Paul F., Tungsten Mineralization at Oreana, Nev.: Econ. Geol., vol. 33, No. 4, June-July 1938, pp 390–425.

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*New Mexico.*—A small shipment of huebnerite concentrates averaging 53.12 percent $WO_3$ was made from Luna County in 1938.

*Utah.*—Shipments from Utah in 1938 totaled only 16 short tons (all scheelite) averaging 25.50 percent $WO_3$. The bulk of the shipments came from the Star Dust mines near Gold Hill operated by Star Dust Mines, Inc. Less than 1 ton of scheelite concentrates running 71.46 percent $WO_3$ was shipped from Juab County.

*Washington.*—Shipments of tungsten concentrates from Washington in 1938 comprised 328 short tons averaging 55.39 percent $WO_3$. Virtually all the shipments (326 tons) came from the Germania mine near Fruitland in Stevens County and were wolframite concentrates containing 55 percent $WO_3$. Operations at the Germania mine were curtailed at the close of 1938. The remaining shipments (2 tons) came from another operator in Stevens County.

## FOREIGN TRADE

Domestic supplies of tungsten are supplemented by imports, principally of concentrates but also in other forms. Imports of ore and concentrates for consumption (tungsten content) dropped sharply in 1938 and totaled only 162,744 pounds compared with 5,561,022 pounds in 1937. Of the 1938 total, 43 percent came from China and 41 percent from British Malaya. In addition, 828,660 pounds of tungsten in concentrates were imported for smelting, refining, and export compared with 502,571 pounds in 1937. There is no record of any exports of tungsten ore or concentrates from this country. Imports of tungsten and tungsten carbide, and of tungstic acid and other compounds of tungsten, were lower in 1938.

*Tungsten ore and concentrates imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Gross weight (pounds) | Tungsten content (pounds) | Value | Gross weight (pounds) | Tungsten content (pounds) | Value |
| Africa: | | | | | | |
| British South, other [1] | 53,000 | 27,740 | $12,681 | | | |
| Union of South Africa | 102,603 | 54,041 | 25,271 | 45,069 | 23,233 | $35,985 |
| Argentina | 257,797 | 138,225 | 71,266 | | | |
| Australia | 566,522 | 306,770 | 212,098 | | | |
| Belgium | 95,200 | 42,197 | 21,485 | | | |
| Bolivia | 143,763 | 74,878 | 29,780 | 2,286 | 705 | 961 |
| British Malaya | 1,590,883 | 975,786 | 538,995 | 108,765 | 67,460 | 58,346 |
| Chile | 18,700 | 8,677 | 4,327 | | | |
| China | 7,104,224 | 3,794,440 | 1,941,844 | 138,380 | 69,986 | 42,350 |
| Hong Kong | 33,600 | 17,472 | 14,511 | | | |
| Japan | 111,152 | 59,560 | 34,078 | | | |
| Mexico | 89,763 | 48,734 | 27,086 | 27,585 | 1,360 | 1,051 |
| Sweden | 22,418 | 12,502 | 6,616 | | | |
| | 10,189,625 | 5,561,022 | 2,940,038 | 322,085 | 162,744 | 138,693 |

[1] Rhodesia (Northern and Southern), Bechuanaland, and Nyasaland Protectorate.

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*Tungsten in metal and compounds imported for consumption in the United States, 1937–38, by countries*

| Country | Tungsten (metal) and tungsten carbide [1] | | | | Tungstic acid and other compounds of tungsten | | | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | | 1938 | | 1937 | | 1938 | |
| | Tungsten content (pounds) | Value | Tungsten content (pounds) | Value | Tungsten content (pounds) | Value | Tungsten content (pounds) | Value |
| Austria | 1,600 | $6,174 | [2] 220 | [2] $701 | | | | |
| Canada | 1,046 | 1,044 | | | 30 | $75 | | |
| France | | | | | | | 28 | $523 |
| Germany | 21 | 170 | [2] 1,565 | [2] 6,822 | 492 | 1,586 | 169 | 680 |
| Hungary | | | | | | | 44 | 403 |
| Switzerland | 9,819 | 12,538 | | | | | | |
| United Kingdom | 121,473 | 111,987 | 21,029 | 23,994 | | | | |
| | 133,959 | 131,913 | 22,814 | 31,517 | 522 | 1,661 | 241 | 1,606 |

[1] Includes combinations containing either metal or carbide.
[2] Austria included with Germany beginning May 6.

## USES

The principal uses of tungsten are in the manufacture of high-speed-tool steels, cemented tungsten carbides, stellites, and electric-light and radio-tube filaments; in the preparation of various chemicals, such as pigments; and in the tanning of white leather. In recent years cemented tungsten carbide has been employed widely in the commercial field. Methods of manufacture, as well as properties and uses, have been described by Sykes.[9] A new alloy of tungsten with 4-percent copper and 6-percent nickel is said to be a suitable material for radium containers. A new process [10] for combining tungsten by electrodeposition with other metals is said to be susceptible to close control.

## WORLD PRODUCTION

World output of tungsten was lower in 1938 than in 1937, when a new peak was established. Although complete figures are not available, preliminary data indicate that world production in 1938 may have reached 32,000 metric tons.

[9] Sykes, W. P., Cemented Tungsten Carbide Alloys: Metals Technol. Am. Inst. Min. and Met. Eng., vol. 5, No. 4, June 1938, pp. 1–11.
[10] Armstrong, H. H. and Menefee, A. B., Electroplating Method and Product: U. S. Patent 2,145,745 January 31, 1939.

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*World production of tungsten ores, 1934–38, by countries, in metric tons of concentrates, containing 60 percent $WO_3$*

[Compiled by M. T. Latus]

| Country [1] | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | | | |
| Mexico | 80 | 54 | 57 | 33 | 76 |
| United States (shipments) | 1,859 | 2,173 | 2,370 | 3,175 | 2,761 |
| | 1,939 | 2,227 | 2,427 | 3,208 | 2,837 |
| South America: | | | | | |
| Argentina | 392 | 579 | 702 | [2] 1,063 | ([3]) |
| Bolivia [2] | 794 | 1,423 | 1,741 | 1,802 | 2,530 |
| Chile | | 7 | 3 | 5 | ([3]) |
| Peru | 12 | 57 | 92 | 30 | 170 |
| | 1,198 | 2,066 | 2,538 | 2,900 | ([3]) |
| Europe: | | | | | |
| Germany (Saxony) | 1 | | | | ([3]) |
| Great Britain (Cornwall) | 223 | 256 | 221 | 148 | 258 |
| Italy | | | | 3 | ([3]) |
| Norway | | | | 2 | ([3]) |
| Portugal | 610 | 1,140 | 1,414 | 2,069 | 2,812 |
| Spain | 49 | ([3]) | ([3]) | ([3]) | ([3]) |
| Sweden | | | 62 | 127 | ([3]) |
| | 883 | [4] 1,396 | [4] 1,697 | [4] 2,349 | ([3]) |
| Asia: | | | | | |
| Burma | 3,913 | 4,527 | 5,382 | 5,924 | 3,410 |
| China [2] | 5,099 | 7,998 | 7,638 | 17,895 | 13,387 |
| Chosen | 399 | 949 | 1,849 | 2,058 | ([3]) |
| India, British | | | | 15 | ([3]) |
| Indochina (Tonkin) | 300 | 417 | 503 | 648 | ([3]) |
| Japan | 70 | 96 | 61 | ([3]) | ([3]) |
| Malay States: | | | | | |
| Federated Malay States | 1,921 | 1,720 | 1,712 | 955 | 667 |
| Unfederated Malay States | 90 | 315 | 325 | 279 | ([3]) |
| Netherland India | 1 | 1 | 1 | ([5]) | ([3]) |
| Siam | 36 | 82 | 82 | 257 | ([3]) |
| | 11,829 | 16,105 | 17,553 | [6] 28,031 | ([3]) |
| Africa: | | | | | |
| Egypt | | | | 193 | ([3]) |
| Nigeria | 5 | 16 | 11 | 9 | 49 |
| Southern Rhodesia | 117 | 26 | 88 | 275 | 329 |
| South-West Africa | 18 | 53 | 46 | 41 | 48 |
| Tanganyika Territory | | 6 | 2 | 2 | ([3]) |
| Uganda | | | | 2 | ([3]) |
| Union of South Africa | | 11 | 30 | 40 | 130 |
| | 140 | 112 | 177 | 562 | ([3]) |
| Oceania: | | | | | |
| Australia: | | | | | |
| New South Wales | 59 | 63 | 18 | 66 | ([3]) |
| Northern Territory | 89 | 126 | 141 | 345 | ([3]) |
| Queensland | 41 | 27 | 22 | 110 | 167 |
| Tasmania | 230 | 275 | 245 | 345 | 390 |
| New Zealand | 39 | 61 | 49 | 28 | 57 |
| | 458 | 552 | 475 | 894 | ([3]) |
| | 16,447 | [4] 22,458 | [4] 24,867 | [4] [6] 37,944 | ([3]) |

[1] In addition to the countries listed, tungsten ore is produced in the U.S.S.R., but no data of production are available for the period under discussion.
[2] Exports.
[3] Data not available.
[4] Exclusive of Spain.
[5] Less than 1 ton.
[6] Exclusive of Japan.

*Argentina.*—Argentina is the second largest producer of tungsten in South America. Output comes principally from the Provinces of San Luis and Cordoba; much smaller amounts are produced in San Juan

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and Catamarca. Virtually all the yield is exported, a large part going to Europe.

*Bolivia.*—Bolivia is the largest producer in South America. The largest deposits occur in the Department of Oruro, while smaller deposits are found in Potosi, La Paz, and Cochabamba. Bolivian tungsten concentrates (wolframite and scheelite) are exported, largely to Europe.

*Burma.*—Output in Burma comes principally from the Hermingyi mine near Tavoy and the Mawchi mine in the southern part of Karenni State. The ores from the Mawchi mine are said to be complex in character and not easy to treat for their tin and tungsten contents, but the ores from the Hermingyi are much simpler. The ore reserves at the Mawchi mine are said to contain 3.24 percent tin and tungsten. The proportion of tungsten to tin in the Hermingyi ores is about 2 to 1. Most of the concentrates from India are shipped to the United Kingdom. Exports from Burma in 1938 were 10,598 metric tons.

*China.*—The Sino-Japanese hostilities continued their adverse effect on the flow of tungsten ore from China, the largest world source. The principal production comes from Hunan, Kiangsi, and Kwangtung, where the tungsten-producing areas are not under Japanese control, and the mines still are being worked extensively. Formerly much of the exports moved out of Shanghai, coming from inland through the river ports of Hankow, Hupeh Province; Kiukiang, Kiangsi Province; and Changsha, Hunan Province. With the closing of the Yangtze and Whangpoo Rivers and exhaustion of the stocks on hand in 1937, exports from Shanghai ceased, and Chinese concentrates moved out via the Canton-Hankow Railroad for transshipment at Hongkong. In 1938 Canton fell to the Japanese, and the Chinese Central Government endeavored to route all tungsten ore shipments via South China ports (Swatow, Haiphong, and Macao) not under Japanese control, or through Indochina. Exports in 1938 were 13,387 metric tons (60 percent $WO_3$ basis) compared with 17,895 tons in 1937. There were no exports during the last 2 months of 1938. A large proportion of the exports in 1938, which went principally to Europe, was shipped under barter agreements.

It was reported early in 1939 that the Chinese Government has granted to the Peiping Syndicate, Ltd., exclusive selling rights for Chinese tungsten ore, including the stocks in Honkong.

*India, British.*—There is little or no production of tungsten in India. Production previously credited to India came from Burma, which was split from India as a separate State as of April 1, 1937.

*Malay States.*—The Kramat Pulai mine near Ipoh is the principal producer in the Malay States. The ore is scheelite of good quality, but the reserves are limited. Exports in 1938 amounted to 665 metric tons of concentrates, of which 287 metric tons were scheelite concentrates and the remainder wolframite concentrates. The exportation of tungsten ore containing more than 1.5 percent tin has been prohibited by the High Commissioner of the Federated Malay States, except under written authorization by the Chief Inspector of Mines.

*Portugal.*—Output in Portugal, the largest European producer, in 1938 increased 36 percent over 1937 and nearly doubled the 1936 figure. The Beralt Tin & Wolfram, Ltd., with properties at Panasqueira in the Province of Beira Baixa, district of Castello Branco,

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was the largest producer. The ore is low-grade, and it has been stated that 300 tons of rock must be broken to produce 1 ton of concentrates. Exports (2,450 metric tons in 1938) went to European manufacturers of ferrotungsten.

*Southern Rhodesia.*—The African Continent produces little tungsten; the principal output comes from Southern Rhodesia, where production increased to 329 metric tons in 1938 from 275 tons in 1937.

## VANADIUM

Vanadium output in 1938 maintained the high level reached in 1937, although there was a noticeable shift in sources. The world supply comes from a limited number of operations, principally in four countries, of which Peru normally is the most important. Production in that country, all from the Minasragra mine, dropped abruptly in 1938. A striking feature of the year was the large increase in domestic production (shipments from mines), and in 1938 the United States became the largest producer. Greatly increased output in the Paradox Valley region in Colorado swelled the domestic total. Production in Northern Rhodesia was 59 percent above 1937, while output in the Territory of South-West Africa dropped a little. World sources of vanadium may be supplemented further in future by the recovery of vanadium from the treatment of pig iron made from vanadium-bearing iron ores at ferrous smelters in Germany. A plant for the recovery of vanadium was completed in 1938 in Japan by the Japan Iron Sand Industrial Co.

Despite the large increase in domestic production imports for consumption into this country increased. Purely nominal quotations for vanadium ore were unchanged throughout 1938 at 27½ cents per pound of contained $V_2O_5$.

*Salient statistics of the vanadium industry in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Production: | | | | |
| Carnotite ores [1]—short tons | 1,708 | $65,294 | 4,290 | $158,779 |
| Vanadium contained—pounds | 73,788 | (2) | 173,859 | (2) |
| Vanadium and complex ores—short tons | 129,372 | (3) | 227,397 | [4] 740,000 |
| Vanadium contained—pounds | 1,012,337 | (3) | 1,439,296 | (3) |
| Imports: | | | | |
| Vanadium ores—short tons | 7,403 | 638,799 | 9,981 | 891,475 |
| Vanadium contained—pounds | 1,258,880 | | 1,384,320 | |

[1] Also contained radium and uranium as follows: Radium—1937, 3,141 milligrams; 1938, 7,821 milligrams. Uranium—1937, 20,764 pounds; 1938, 51,705 pounds.
[2] Figures not available.
[3] Bureau of Mines not at liberty to publish figures.
[4] Estimated by Bureau of Mines.

### DOMESTIC PRODUCTION

Production in the United States of vanadium contained in all types of ores from which it was recovered totaled 1,613,155 pounds in 1938 compared with 1,086,125 pounds in 1937. Output came from Arizona, Colorado, Nevada, and Utah, Colorado supplying the largest quantity.

*Arizona.*—Vanadium was produced from the operations of the Molybdenum Gold Mining Co. and the Mammoth-St. Anthony, Ltd.,

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near Mammoth, where complex ores containing recoverable values in gold, silver, lead, molybdenum, and vanadium are treated in a flotation mill operated by the latter company. The mill treated 165,465 short tons of ore, from which 4,191 tons of concentrates containing 238,000 pounds of $V_2O_5$ were recovered. The geology and ore deposits of the Mammoth mining camp area have been described by Peterson.[11] Development work was continued by the International Vanadium Corporation at the Dripping Springs mine near Globe, but there was no production.

*Colorado.*—The production of vanadium in Colorado in 1938 amounted to 1,382,736 pounds in vanadium and carnotite ores. The largest output was from operations of the United States Vanadium Corporation in Paradox Valley. The ore runs under 2 percent $V_2O_5$; and the vanadium is recovered as $V_2O_5$ by roasting the ore with salt, leaching the sodium vanadate with water, and precipitating the $V_2O_5$ with acid. The precipitate is then sintered to a product containing about 88 percent $V_2O_5$.

A 20-ton mill was erected near Gateway, Mesa County, by the Gateway Alloys, Inc., to treat ores mined from nearby claims.

*Nevada.*—Output in 1938—only 7 tons of vanadinite and descloizite concentrates—came from operations at the Spelter mine near Goodsprings, Clark County.

*Utah.*—Vanadium-bearing ores were produced at a number of rather widely scattered locations in Utah. Shipments totaling 172,194 pounds of contained $V_2O_5$ originated in Grand and San Juan Counties in the southeastern part of the State. The largest output was made by the Harbro mines near Cisco, Grand County, and consisted of concentrates containing carnotite.

## FOREIGN TRADE

Imports of vanadium ores in 1938, all from Peru, amounted to 9,981 short tons containing 1,384,320 pounds of vanadium. Data on exports are not given by the Bureau of Foreign and Domestic Commerce, but in 1938 several hundred short tons of vanadium-bearing ore or concentrates were exported to Japan.

## USES

The principal use of vanadium is in the manufacture of special alloy steels and irons. Minor quantities are employed as a catalyst in the manufacture of sulfuric acid in the form of ammonia metavanadate, and in the nonferrous, glass, ceramic, and color industries. Vanadium produces high-strength steel and iron with much less exacting heat treatment than is necessary with other alloys, at a lower cost for both heat treating and machinery.[12]

## WORLD PRODUCTION

Despite the sharply reduced yield in Peru, one of the principal sources, world output in 1938 exceeded that in 1937, owing principally to the large increase in production in the United States. Output in

[11] Peterson, N. P., Work cited in footnote 2.
[12] Priestley, W. J., Vanadium in Steel and Iron: Metals and Alloys, vol. 9, Nos. 8 and 9, August and September 1938, pp. 193–197, 237–241.

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Peru comes from the Minasragra mine of the Vanadium Corporation of America. Exports from Peru comprised 7,453 metric tons of ore and 2,886 tons of concentrates, all of which moved to the United States. Three mines—the Abenab and Baltika of the Southwest Africa Co., Ltd., and the Nageib mine of the Otavi Minen and Eisenbahn Gesellschaft—contributed to the total in the Territory of South-West Africa. All the ore, which runs about 19.75 percent $V_2O_5$, is exported to England and Europe. Production in Northern Rhodesia was fused vanadic oxide from operations of the Rhodesian Broken Hill Development Co., Ltd., which also produces zinc.

*World production of vanadium in ores and concentrates, 1934–38, in metric tons*

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Mexico | | | | 45 | 180 |
| Northern Rhodesia | 3 | 173 | 204 | 235 | 374 |
| Peru | [1] 75 | 67 | 161 | 583 | 102 |
| South-West Africa | 34 | 176 | 547 | 591 | 557 |
| United States | [2] | [2] | 63 | 493 | 732 |

[1] Shipments from stock.
[2] Bureau of Mines not at liberty to publish figures.



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# BAUXITE AND ALUMINUM

By HERBERT A. FRANKE AND M. E. TROUGHT [1]

## SUMMARY OUTLINE


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| Chemical | 637 | Bauxite production | 646 |
| Oil refining and refractory | 639 | Aluminum production | 647 |
| Prices | 639 | Aluminum consumption | 648 |
| Foreign trade | 639 | Review by countries | 648 |


As a result of the recession in industrial activity, production and consumption of aluminum in the United States in 1938 fell below the records established in 1937. Primary aluminum production declined 2 percent and consumption 47 percent. Quoted prices of aluminum remained unchanged throughout the year. The United States Department of Justice continued its suit against the Aluminum Co. of America, charging violation of the antitrust laws. Under the Canadian Trade Agreement the United States import duty on aluminum was reduced from 4 to 3 cents per pound. At the close of the year the outlook was improved by the upturn in business during the last quarter.

The domestic bauxite industry likewise experienced a downward trend in 1938, as indicated by decreases in production, consumption, and foreign trade. Although total bauxite consumption was only 6 percent lower, domestic production fell 26 percent, largely as a result of the increased use of foreign ore. Imports and exports of bauxite declined 10 and 53 percent, respectively, but net imports advanced 23 percent. The proportion of domestic needs supplied by domestic mines thus dropped from 60 percent in 1937 to 47 percent in 1938. Quoted prices for bauxite in 1938 differed little from those in 1937.

*Salient statistics of the bauxite and aluminum industries in the United States, 1929 and 1937–38*

| | 1929 | 1937 | 1938 |
|---|---|---|---|
| Bauxite: | | | |
| Production, long tons | 365,777 | [1] 439,000 | [1] 323,818 |
| Value | $2,265,638 | $2,444,686 | $1,812,545 |
| Imports, long tons | 380,812 | 507,423 | 455,693 |
| Exports (including concentrates), do | 133,551 | 123,191 | 57,726 |
| World production, do | 2,115,000 | 3,621,000 | [1] 3,789,000 |
| Aluminum: | | | |
| Primary production, short tons | 113,987 | 146,341 | 143,441 |
| Value | $51,864,000 | $55,609,000 | $56,659,000 |
| Quoted price per pound [2], cents | 23.9 | 20.1 | 20.0 |
| Secondary production, short tons | 48,400 | 62,560 | 38,800 |
| Imports | $10,860,009 | $8,177,600 | $3,379,018 |
| Exports | $7,971,085 | $2,943,214 | $5,484,047 |
| World production, short tons | 312,300 | 530,800 | [2] 619,300 |

[1] Dried bauxite equivalent; figure not strictly comparable with 1929.
[2] Estimated.
[3] New York: 1929, virgin metal 98–99 percent pure; 1937–38, 99 percent plus, pure virgin ingot, according to Metal Statistics 1939, published by American Metal Market.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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Although official data on world output of bauxite and aluminum in 1938 are incomplete, both commodities probably established new high records. For the third time in the last 5 years the production of aluminum in Germany exceeded that in the United States. Of the total output of the world, Germany contributed 29 percent and the United States 23 percent. Canada, U. S. S. R., and France ranked next in importance as producers. The total consumption of more than 500,000 short tons of aluminum in 1938 can be attributed partly to the strategic importance of the metal in a war-threatened world. Totalitarian countries have found aluminum an expedient substitute for many deficient metals. In addition technologic research has developed many new industrial uses.

Although world output of aluminum in 1938 increased about 17 percent over 1937, bauxite production advanced only 5 percent. France, the leading bauxite-producing country, maintained the high output level of 1937, and British Guiana, Hungary, the U. S. S. R., and Yugoslavia achieved a substantial increase in production. The United States ranked seventh in importance and produced only 8 percent of the total.

## BAUXITE

### PRODUCTION

Domestic production of bauxite in 1938 was 26 percent less in quantity and value compared with 1937. The entire decline can be attributed to decreased production at mines in Arkansas and Georgia as shipments from Alabama increased. The underground and open-pit mines in Saline and Pulaski Counties, Ark., produced 95 percent of the total domestic output. The remaining 5 percent was contributed by mines in Barbour and Henry Counties, Ala., and in Sumter County, Ga.

Heretofore reported shipments of bauxite have included crude, dried, and calcined ore but have not considered the difference in the moisture content of the various products which may vary widely according to locality and the amount of processing involved. These statistics did not provide a suitable basis for comparing output by years, localities, or consuming industries. To place all tonnages on a comparable basis, shipments now have been converted to a theoretical dried bauxite equivalent, which not only presents a more accurate picture of the details of the domestic industry but also affords a more equitable comparison of the domestic output with imports and foreign production.

The actual shipments shown in the table represent the condition in which the ore was shipped by the mining companies to consumers. Some consumers maintain processing plants near the mines and in consequence ship the products to their final consuming plants in more concentrated form than they are purchased from the mines. Very little crude ore is shipped any great distance. Net shipments from mining areas in 1938, including material moving both from producers' plants and consumers' processing plants, comprised 207,132 tons of dried bauxite, 50,939 tons of calcined, and only 9,408 tons of crude. Shipments of activated bauxite, although only partly calcined, are included with those of calcined ore.

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The following table shows both the condition of bauxite as shipped and the estimated dried bauxite equivalent of these shipments, by States.

*Bauxite shipped by producers in the United States, 1934–38, by States*

| State and year | Long tons | | | | | Value, f. o. b. mine |
|---|---|---|---|---|---|---|
| | Crude | Dried | Calcined | Total | | |
| | | | | As shipped | Dried bauxite equivalent | |
| Alabama and Georgia: | | | | | | |
| 1934 | 187 | 11,887 | ---------- | 12,074 | 12,050 | $71,991 |
| 1935 | 100 | 14,021 | ---------- | 14,121 | 14,108 | 91,293 |
| 1936 | 91 | 16,971 | ---------- | 17,062 | 17,050 | 109,327 |
| 1937 | 3,410 | 14,627 | ---------- | 18,037 | 17,491 | 121,825 |
| 1938 | 5,532 | [1] 12,542 | ---------- | 18,074 | 17,250 | 132,882 |
| Arkansas: | | | | | | |
| 1934 | 3,002 | 121,057 | 21,705 | 145,764 | 157,312 | 1,057,062 |
| 1935 | 21,594 | 164,349 | 33,848 | 219,791 | 233,263 | 1,465,302 |
| 1936 | 49,243 | 268,900 | 36,800 | 354,943 | 365,751 | 2,089,196 |
| 1937 | 98,340 | 257,023 | 46,832 | 402,195 | 421,509 | 2,322,861 |
| 1938 | 72,097 | 194,945 | [1] 26,238 | 293,280 | 306,568 | 1,679,663 |
| Total United States: | | | | | | |
| 1934 | 3,189 | 132,944 | 21,705 | 157,838 | 169,362 | 1,129,053 |
| 1935 | 21,694 | 178,370 | 33,848 | 233,912 | 247,371 | 1,556,595 |
| 1936 | 49,334 | 285,871 | 36,800 | 372,005 | 382,801 | 2,198,523 |
| 1937 | 101,750 | 271,650 | 46,832 | 420,232 | 439,000 | 2,444,686 |
| 1938 | 77,629 | [1] 207,487 | [1] 26,238 | 311,354 | 323,818 | 1,812,545 |

[1] Includes small quantity of activated bauxite.

*Bauxite producers in the United States in 1938*

AMERICAN CYANAMID & CHEMICAL CORPORATION, 30 Rockefeller Plaza, New York, N. Y.—Ozark underground mine, Saline County, and Rauch underground mine, Pulaski County, Ark.; Hatton underground mine, Sumter County, Ga.

ARKANSAS BAUXITE CORPORATION, Bauxite, Ark. (mining by West Bauxite Mining Co.).—Standard and McDonald underground mines and Bizzell open-pit mine, Saline County, Ark.

CONSOLIDATED CHEMICAL INDUSTRIES, INC., 811 Petroleum Building, Houston, Tex.—Alexander underground mine, Saline County, Ark.

CROUCH MINING CO., INC. (General Abrasive Co.), P. O. Box 35, Bridge Station, Niagara Falls, N. Y.—England underground mine, Pulaski County, Ark.

DIXIE BAUXITE CO., INC., Sweet Home, Ark.—Dixie No. 2 underground mine, Pulaski County, Ark.

BENJAMIN EASTERLIN, Americus, Ga.—Easterlin open-pit mine, Sumter County, Ga.

FLORIDIN CO., 220 Liberty Street, Warren, Pa.—Scott open-pit mine, Henry County, Ala.

PULASKI BAUXITE CO., 301 Southern Building, Little Rock, Ark.—Pulaski open-pit mine, Pulaski County, Ark.

REPUBLIC MINING & MANUFACTURING CO., 230 Park Avenue, New York, N. Y.—Lantz, Bertha, Maud Nos. 2 and 3, Sections 14, 23, and 26 open-pit mines, Saline County, Ark.; Ratcliffe open-pit and underground mine, Pulaski County, Ark.; Neilson, Davis, and Crosscut No. 23 underground mines, Saline County, Ark.; Eufaula open-pit mines (chiefly Baker and Clarke), Barbour and Henry Counties, Ala.

Most of these producers operate beneficiating and drying or calcining plants near their mines. Other companies that purchase bauxite but operate processing plants in the mining area are: Aluminum Ore Co., East St. Louis, Ill.—at Sweet Home, Ark.; Max B. Miller & Co., Inc., 501 Fifth Avenue, New York, N. Y.—at West Bauxite, Ark.; Norton Co., Worcester, Mass.—at Bauxite, Ark.; and Porocel Corpo-

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ration, 260 South Broad Street, Philadelphia, Pa.—plant under construction at Berger, Ark.

There were only two new bauxite-producing concerns in 1938—the Consolidated Chemical Industries, Inc., and the Floridin Co. The latter has acquired bauxite deposits in Henry and Barbour Counties, Ala., as well as the drying plant of Charles Lennig & Co. at Eufaula, Ala. The crude bauxite produced by the company in Henry County in 1938 was shipped to Quincy, Fla., to be activated. The Crouch Mining Co., Inc., plans to complete sinking a shaft on its Young bauxite property, Saline County, in 1939. Both Charles Lennig & Co. and J. M. Mathison, producers of bauxite in southeastern Alabama in 1937, reported no shipments in 1938. Of significance recently in the industry was the installation of magnetic separation, screening, and other processing equipment in the Arkansas mining area (see Minerals Yearbook 1938, p. 579), chiefly to serve demands of the chemical and oil-refining industries. Max B. Miller & Co., Inc., produced activated bauxite at its new plant near that of the Arkansas Bauxite Corporation, and the Porocel Corporation began erection of a processing plant near that of the American Cyanamid & Chemical Corporation, which controls the new concern jointly with the Attapulgus Clay Co.

Aluminum is classed as one of the strategic materials by the Army and Navy Munitions Board, chiefly because of the limited quantities of commercial-grade bauxite available in the United States. Owing to recent interest in national defense it seems appropriate at this time to present a table containing data on bauxite production and consumption since 1910.

*Production, imports, exports, and apparent consumption of bauxite in the United States, 1910–38, in long tons*

| Year | Domestic production | | | | | Imports | Exports | Apparent consumption |
|---|---|---|---|---|---|---|---|---|
| | Arkansas | Alabama | Georgia | Tennessee | Total | | | |
| 1910 | 110,406 | 9,517 | 23,579 | 5,430 | 148,932 | 15,669 | (1) | 164,601 |
| 1911 | 122,183 | 8,848 | 21,322 | 3,265 | 155,618 | 43,222 | (1) | 198,840 |
| 1912 | 117,299 | 14,173 | 19,587 | 8,806 | 159,865 | 26,214 | (1) | 186,079 |
| 1913 | 169,871 | 9,192 | 18,217 | 12,961 | 210,241 | 21,456 | (1) | 231,697 |
| 1914 | 195,247 | 7,829 | 10,718 | 5,524 | 219,318 | 24,844 | [1] 5,374 | 238,788 |
| 1915 | 268,796 | 10,290 | 14,718 | 3,237 | 297,041 | 3,420 | 16,082 | 284,379 |
| 1916 | 375,910 | 5,763 | 40,388 | 3,039 | 425,100 | 30 | 17,939 | 407,191 |
| 1917 | 506,556 | 8,281 | 52,901 | 952 | 568,690 | 7,691 | 21,791 | 554,590 |
| 1918 | 562,892 | 4,928 | 35,637 | 2,264 | 605,721 | 3,653 | 19,711 | 589,663 |
| 1919 | 333,490 | 3,700 | 37,201 | 2,175 | 376,566 | 6,082 | 17,701 | 364,947 |
| 1920 | 481,279 | 4,044 | 34,397 | 1,588 | 521,308 | 42,895 | 22,257 | 541,946 |
| 1921 | 124,850 | 4,200 | 10,200 | 300 | 139,550 | 27,587 | 5,942 | 161,195 |
| 1922 | 266,790 | 10,430 | 30,420 | 1,960 | 309,600 | 23,656 | 19,617 | 313,639 |
| 1923 | 493,880 | 245 | 22,553 | 6,012 | 522,690 | 119,020 | 78,560 | 563,150 |
| 1924 | 327,630 | ---------- | 16,140 | 3,800 | 347,570 | 201,974 | 77,065 | 472,479 |
| 1925 | 296,320 | ---------- | 18,220 | 2,000 | 316,540 | 353,696 | 78,633 | 591,603 |
| 1926 | 371,570 | ---------- | 19,680 | 1,000 | 392,250 | 281,644 | 87,770 | 586,124 |
| 1927 | 303,830 | 4,060 | 13,050 | ---------- | 320,940 | 356,580 | 121,858 | 555,662 |
| 1928 | 361,236 | 6,748 | 6,982 | 460 | 375,426 | 350,111 | 112,984 | 612,553 |
| 1929 | 351,054 | [2] 14,723 | (2) | ---------- | 365,777 | 380,812 | 133,551 | 613,038 |
| 1930 | 315,273 | [2] 15,339 | (2) | ---------- | 330,612 | 409,678 | 104,504 | 635,786 |
| 1931 | 186,697 | [2] 9,198 | (2) | ---------- | 195,895 | 306,490 | 88,370 | 414,015 |
| 1932 | 89,779 | [2] 6,570 | (2) | ---------- | 96,349 | 205,620 | 28,474 | 273,495 |
| 1933 | 142,179 | [2] 11,997 | (2) | ---------- | 154,176 | 149,548 | 21,760 | 281,964 |
| 1934 [3] | 157,312 | [2] 12,050 | (2) | ---------- | 169,362 | 166,653 | 84,834 | 251,181 |
| 1935 [3] | 233,263 | [2] 14,108 | (2) | ---------- | 247,371 | 199,959 | 141,060 | 306,270 |
| 1936 [3] | 365,751 | [2] 17,050 | (2) | ---------- | 382,801 | 322,790 | 144,445 | 561,146 |
| 1937 [3] | 421,509 | [2] 17,491 | (2) | ---------- | 439,000 | 507,423 | 210,657 | 735,766 |
| 1938 [3] | 306,568 | [2] 17,250 | (2) | ---------- | 323,818 | 455,693 | 90,341 | 689,170 |

[1] Not separately classified prior to July 1914.
[2] Georgia included with Alabama.
[3] Dried bauxite equivalent; figures not strictly comparable with earlier years.

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## CONSUMPTION BY INDUSTRIES

Virtually all the bauxite produced in and imported into the United States is consumed by the aluminum, chemical, abrasive, oil-refining, and refractory industries. A list of the principal domestic bauxite consumers appears on pages 669 and 670 of Minerals Yearbook 1937.

The following table shows producers' shipments of bauxite to consumers in the condition shipped—that is, crude, dried, activated, and calcined ore—and the dried bauxite equivalent of these products. Unless otherwise noted all mention of domestic production and consumption in the discussion that follows is in terms of dried bauxite.

*Bauxite shipped by producers in the United States, 1934–38, by consuming industries, in long tons*

| Industry | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | As shipped [1] | Dried bauxite equivalent | As shipped [1] | Dried bauxite equivalent | As shipped [1] | Dried bauxite equivalent | As shipped [1] | Dried bauxite equivalent | As shipped [1] | Dried bauxite equivalent |
| Aluminum | 55,630 | 55,630 | 112,154 | 112,154 | 211,990 | 211,990 | 211,275 | 209,476 | 146,687 | 146,365 |
| Chemical | 67,153 | 66,765 | 66,316 | 66,303 | 73,972 | 73,960 | 75,561 | 75,321 | 61,461 | 61,231 |
| Abrasive [2] | 34,580 | 46,492 | 53,684 | 66,381 | 84,363 | 94,454 | 126,339 | 146,285 | 92,874 | 105,702 |
| Oil refining | | | | | | | 3,602 | 3,095 | 8,536 | 8,298 |
| Refractory and other [2] | 475 | 475 | 1,758 | 2,533 | 1,680 | 2,397 | 3,455 | 4,823 | 1,796 | 2,222 |
| | 157,838 | 169,362 | 233,912 | 247,371 | 372,005 | 382,801 | 420,232 | 439,000 | 311,354 | 323,818 |

[1] Crude, dried, activated, and calcined.
[2] Small quantity of bauxite shipped to makers of refractories probably included under "abrasive."

The supply of bauxite (dried-bauxite basis)—that is, domestic production plus net imports—totaled 689,170 tons in 1938 compared with 735,766 tons in 1937. Net imports accounted for 53 percent of the total in 1938 compared with 40 percent in 1937.

*Aluminum.*—All domestic ore used in aluminum manufacture comes from Arkansas. Shipments in 1938 represented 45 percent of the total bauxite output of the United States. Consumption was 30 percent less than in 1937, owing principally to the increased proportion of imported ore used. More than two-thirds of the industry's bauxite requirements came from South America, chiefly Surinam. All bauxite used by the industry was refined at East St. Louis, Ill., and at the new Bayer-process plant, Mobile, Ala.

*Abrasive.*—The abrasive industry consumed 28 percent less bauxite in 1938 than in 1937. It remained the second largest consumer of domestic ore and took 33 percent of the total bauxite shipped by producers. Calcined bauxite containing 78 to 84 percent $Al_2O_3$ and refined alumina are used in the manufacture of artificial corundum, emery, and other abrasives.

*Chemical.*—Domestic shipments of bauxite to the chemical industry decreased 15 percent in 1938 and represented 20 percent of the total ore shipments. Of the total bauxite consumed by this industry domestic ore comprised 52 percent and imported ore, chiefly from British Guiana, 48 percent. Producers of aluminum salts reported the use of bauxite equivalent to 173,000 long tons of dried bauxite in 1938, only 1 percent less than in 1937. These manufacturers also used 4,068 short tons of alumina, 610 tons of aluminum metal, and a

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small quantity of clay and alunite. Domestic shipments of aluminum salts in 1938 dropped 12 percent.

*Aluminum salts and alumina produced in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Producers | Short tons | Producers | Short tons |
| Aluminum salts: | | | | |
| Alum: | | | | |
| Ammonia | 6 | 5,440 | 7 | 3,754 |
| Potash | 4 | 3,098 | 3 | 1,715 |
| Aluminum chloride: | | | | |
| Liquid | 6 | 2,245 | 6 | 2,167 |
| Crystal | 2 | 7,026 | 2 | 6,240 |
| Anhydrous | 4 | | 4 | |
| Aluminum sulfate: | | | | |
| Commercial: | | | | |
| General | 14 | 397,733 | 16 | 353,044 |
| Municipal | 10 | 14,125 | 10 | 10,278 |
| Iron-free | 7 | 15,103 | 8 | 15,082 |
| Sodium-aluminum sulfate | 2 | 24,513 | 2 | 24,961 |
| Sodium aluminate | 7 | | 7 | |
| Total aluminum salts | | 469,283 | | 417,241 |
| Alumina [1] | 7 | 24,904 | 7 | 29,043 |

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, hydrate, and monohydrate D produced for sale.

*Aluminum salts and alumina shipped by producers in the United States, 1937–38*

| | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Shippers | Short tons | Value | | Shippers | Short tons | Value | |
| | | | Total | Average | | | Total | Average |
| Aluminum salts: | | | | | | | | |
| Alum: | | | | | | | | |
| Ammonia | 6 | 5,016 | $262,245 | $52 | 7 | 4,079 | $218,019 | $53 |
| Potash | 3 | 2,713 | 152,895 | 56 | 3 | 2,085 | 121,174 | 58 |
| Aluminum chloride: | | | | | | | | |
| Liquid | 5 | 2,201 | 96,910 | 44 | 6 | 2,174 | 99,208 | 46 |
| Crystal | 2 | 6,823 | 645,437 | 95 | 2 | 6,166 | 521,492 | 85 |
| Anhydrous | 4 | | | | 4 | | | |
| Aluminum sulfate: | | | | | | | | |
| Commercial: | | | | | | | | |
| General | 14 | 394,507 | 8,793,753 | 22 | 16 | 349,051 | 7,345,471 | 21 |
| Municipal | 10 | 14,034 | 213,841 | 15 | 10 | 10,689 | 161,160 | 15 |
| Iron-free | 7 | 16,027 | 541,563 | 34 | 8 | 14,508 | 417,446 | 29 |
| Sodium-aluminum sulfate | 2 | 25,573 | 1,386,348 | 54 | 2 | 24,153 | 1,313,384 | 54 |
| Sodium aluminate | 7 | | | | 7 | | | |
| Total aluminum salts | | 466,894 | 12,092,992 | | | 412,905 | 10,197,354 | |
| Alumina [1] | 7 | 24,813 | 1,800,412 | 73 | 7 | 29,175 | 1,955,383 | 67 |

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, hydrate, and monohydrate D.

*Aluminum salts shipped in, imported into, and exported from the United States, 1934–38*

| Year | Domestic shipments | | Imports | | Exports (aluminum sulfate) [1] | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 368,682 | $9,305,651 | 644 | $31,052 | 30,881 | $594,440 |
| 1935 | 402,717 | 10,082,936 | 1,424 | 68,636 | 33,091 | 685,347 |
| 1936 | 444,660 | 10,965,660 | 2,106 | 50,608 | 28,788 | 578,001 |
| 1937 | 466,894 | 12,092,992 | 2,864 | 61,665 | 31,807 | 679,214 |
| 1938 | 412,905 | 10,197,354 | 1,871 | 40,189 | 27,715 | 578,330 |

[1] Also "other aluminum compounds" as follows: 1934, 488 short tons valued at $93,440; 1935, 691 tons, $126,435; 1936, 1,483 tons, $250,262; 1937, 2,609 tons, $426,363; 1938, 1,770 tons, $257,545.

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New plants producing aluminum sulfate in 1938 were those of the Natural Products Refining Co., at Jersey City, N. J., and the Kimberly-Clark Corporation, at Niagara, Wis. The American Cyanamid & Chemical Corporation started construction of new aluminum sulfate plants at Mobile, Ala., and Georgetown, S. C.

*Oil refining, refractory, and other.*—Although activated bauxite began partly to replace natural fuller's earth in decolorizing lubricating oils by percolation methods only in 1937, it already is used widely in Pennsylvania and the Mid-Continent field. Owing largely to the property of indefinite revivification, activated bauxite granules costing $30 to $40 a short ton f. o. b. Arkansas can compete with the lower-cost, shorter-lived fuller's earth ($22 a ton).

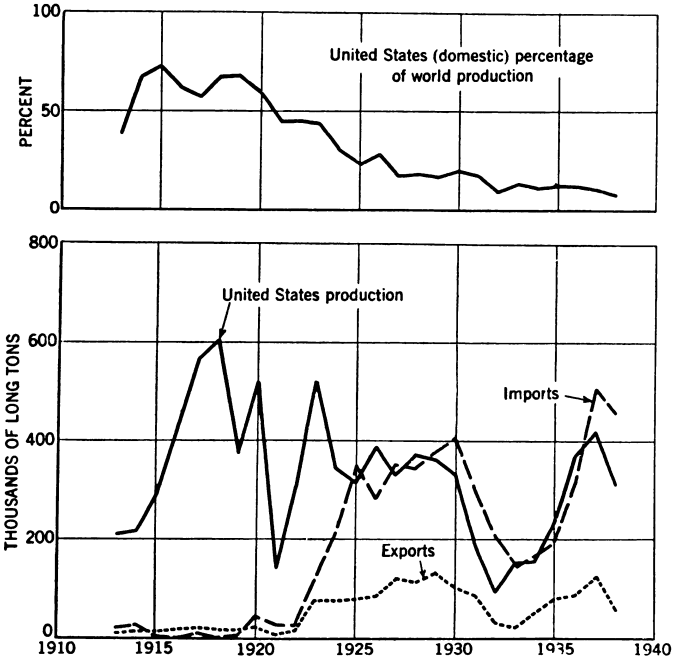


FIGURE 1.—Trends in production, imports, and exports of bauxite, 1913–38.

The refractory industry consumed only about 1 percent of the domestic output of bauxite in 1938, and all the domestic calcium aluminate cement was made from imported bauxite obtained largely from Greece.

## PRICES

In 1938 producers of bauxite in the United States reported selling prices ranging from about $2 per long ton for crude, f. o. b. mines, to $40 for activated ore. The weighted average selling price for crushed dried bauxite, f. o. b. mines, was $5.25 per ton and for calcined bauxite, f. o. b. Arkansas mines, $12.38 per ton. The average value for all grades of domestic ores as sold was $5.82 per ton.

## FOREIGN TRADE

Bauxite imports in 1938 declined 10 percent compared with 1937, the largest import year on record, and exports (dry equivalent) 57

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percent. Of the 1938 imports (chiefly dried ore), Surinam furnished 386,756 long tons, British Guiana 60,044, Greece 8,400, and Netherland India 493. Imports by customs districts were as follows: 279,260 tons to New Orleans, 128,661 to Mobile, 32,929 to Philadelphia, 8,400 to Chicago, and 6,443 to Massachusetts. No bauxite was imported from France in 1938, and apparently the small shipment from Netherland India was for trial purposes only. In addition to bauxite, 64 tons of alumina were imported, almost all from Canada.

*Bauxite imported into and exported from the United States, 1934–38*

| Year | Imports for consumption | | Exports (including bauxite concentrates) | | Year | Imports for consumption | | Exports (including bauxite concentrates) | |
|---|---|---|---|---|---|---|---|---|---|
| | Long tons | Value | Long tons | Value | | Long tons | Value | Long tons | Value |
| 1934 | 166,653 | $1,201,710 | 51,415 | $1,039,955 | 1937 | 507,423 | $3,609,063 | 123,191 | $3,456,916 |
| 1935 | 199,959 | 1,448,592 | 82,491 | 2,191,167 | 1938 | 455,693 | 3,521,325 | 57,726 | 1,459,491 |
| 1936 | 322,790 | 2,370,778 | 84,471 | 2,322,915 | | | | | |

All exports in 1938 classified as bauxite and other aluminum ores, 43,759 long tons (chiefly calcined ore for use in abrasives), went to Canada. Exports of bauxite concentrates and alumina totaled 13,967 tons and were consigned as follows: Norway, 8,966 tons; Canada, 3,926; Sweden, 1,073; China and Denmark, 1 each; and less than a ton each to Brazil and France.

## ALUMINUM

### PRODUCTION

*Primary.*—Domestic production of primary aluminum in 1938 decreased 2 percent in quantity but increased 2 percent in value compared with 1937. The value of aluminum as reported by domestic producers averaged 19.75 cents per pound in 1938 compared with 19 cents in 1937. Of the new aluminum produced in 1938, 40 percent was made at Alcoa, Tenn.; 34 percent at Massena, N. Y.; 14 percent at Badin, N. C.; and 12 percent at Niagara Falls, N. Y.

*Aluminum produced in the United States, 1934–38*

| Year | Primary metal | | Secondary metal | | Year | Primary metal | | Secondary metal | |
|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value [1] | | Pounds | Value | Pounds | Value [1] |
| 1934 | 74,177,000 | $14,094,000 | 92,800,000 | $17,632,000 | 1937 | 292,681,000 | $55,609,000 | 125,120,000 | $23,773,000 |
| 1935 | 119,295,000 | 22,070,000 | 102,800,000 | 19,018,000 | 1938 | 286,882,000 | 56,659,000 | 77,600,000 | 15,326,000 |
| 1936 | 224,929,000 | 41,612,000 | 103,000,000 | 19,055,000 | | | | | |

[1] Based on average price of primary aluminum as reported to Bureau of Mines.

A large part of the expansion program started by the Aluminum Co. of America in 1937 was completed in 1938. On July 26, 1938, the 250-ton-capacity (daily) plant at Mobile, Ala., began producing alumina from South American bauxite by the Bayer process. Ten 5,500-kilowatt, double-tank, grid-control, mercury-arc rectifier units were installed at the Alcoa reduction plant and five at Massena. A

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new sand foundry and forging plant was completed near Los Angeles, Calif., to serve increasing demands for fabricated aluminum alloys by the aircraft industry on the Pacific coast. Other completed developments included a new extrusion mill at Lafayette, Ind., and expansion of the rolling mill at Edgewater, N. J.

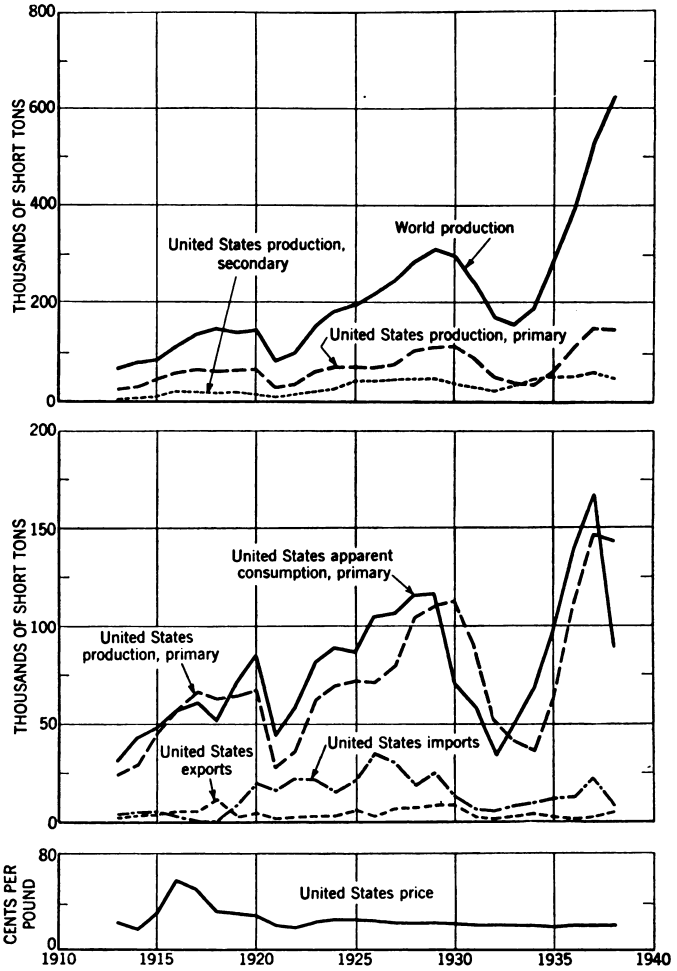


FIGURE 2.—Trends in production, imports and exports, apparent consumption, and average quoted prices of aluminum, 1913–38. Price is for No. 1 virgin 98–99 percent at New York through 1929, thereafter for 99 percent plus virgin ingot, as reported by American Metal Market.

The suit against the Aluminum Co. of America et al., by the United States of America through the Department of Justice, opened on June 30, 1938, in the District Court of the United States for the Southern District of New York. The trial was recessed by Federal Judge Francis G. Caffey on June 30, 1938, until October 13, 1938. By the end of 1938 the Government was still presenting testimony in support of its petition, which asks for dissolution of the company, charging that it is a monopoly in violation of the antitrust laws.

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*Secondary.*—Output of secondary aluminum declined 38 percent in 1938 compared with 1937, according to J. P. Dunlop, of the Bureau of Mines. The metal recovered unalloyed totaled 16,700 short tons and that in alloys (mainly No. 12), 22,100 tons. Most of the scrap metal collected is consumed as soon as it is remelted. To keep pace with the complexity of aluminum-alloy scrap, secondary refiners maintain laboratories to obtain chemical analyses and to check the specifications of the refined or finished alloys.[2] Production of secondary aluminum was equivalent to 27 percent of the primary output in 1938. Additional details on production of secondary aluminum in 1938 are given in the chapter on Secondary Metals in this volume.

*Historical record.*—Inasmuch as the military and civilian requirements for aluminum have increased greatly, particularly for use in aircraft and heavy transportation, the metal is listed by the Army and Navy Munitions Board as a strategic material. In view of the importance of aluminum for these purposes, a table comprising data on production and consumption since 1910 is presented in this review. Data on the production of aluminum since 1893 are shown in a succeeding table.

*Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1910–38, in pounds*

| Year | Primary aluminum | | | | Secondary production |
|---|---|---|---|---|---|
| | Production [1] | Imports [2] | Exports [2] | Apparent consumption [3] | |
| 1910 | 35,402,000 | (4) | (5) | 35,402,000 | (4) |
| 1911 | 38,396,000 | 4,173,308 | (5) | 42,569,308 | (4) |
| 1912 | 41,806,000 | 22,741,271 | (5) | 64,547,271 | (4) |
| 1913 | 47,279,000 | 25,095,441 | (5) | 72,374,441 | 9,308,000 |
| 1914 | 57,973,000 | 17,942,958 | (5) | 75,915,958 | 9,044,000 |
| 1915 | 90,504,000 | 9,293,574 | (5) | 99,797,574 | 17,000,000 |
| 1916 | 115,107,000 | 6,698,615 | (5) | 121,805,615 | 38,600,000 |
| 1917 | 129,861,000 | 89,291 | 5 10,020,404 | 119,929,887 | 32,200,000 |
| 1918 | 124,725,000 | 1,690,683 | 24,135,234 | 102,280,449 | 30,100,000 |
| 1919 | 128,477,000 | 13,852,065 | 5,020,352 | 137,308,713 | 37,382,000 |
| 1920 | 138,042,000 | 39,298,649 | 9,407,631 | 167,933,018 | 31,000,000 |
| 1921 | 54,532,000 | 32,559,017 | 2,196,378 | 84,894,639 | 17,800,000 |
| 1922 | 73,633,000 | 43,891,933 | 4,347,020 | 113,177,913 | 32,580,000 |
| 1923 | 128,658,000 | 42,476,789 | 5,539,671 | 165,595,118 | 42,600,000 |
| 1924 | 150,564,000 | 31,809,941 | 6,343,512 | 176,030,429 | 54,000,000 |
| 1925 | 140,116,000 | 41,997,178 | 12,642,034 | 169,471,144 | 88,000,000 |
| 1926 | 147,386,000 | 71,391,717 | 7,634,171 | 211,143,546 | 88,400,000 |
| 1927 | 163,607,000 | 62,575,222 | 14,522,560 | 211,659,662 | 92,400,000 |
| 1928 | 210,544,000 | 38,847,007 | 15,728,281 | 233,662,726 | 95,600,000 |
| 1929 | 227,973,000 | 50,880,823 | 17,032,117 | 232,747,506 | 96,800,000 |
| 1930 | 229,037,000 | 25,461,179 | 17,329,511 | 141,864,968 | 77,200,000 |
| 1931 | 177,545,000 | 14,832,807 | 4,700,878 | 116,993,929 | 60,600,000 |
| 1932 | 104,888,000 | 8,184,713 | 4,436,690 | 69,688,023 | 48,000,000 |
| 1933 | 85,125,000 | 15,246,696 | 5,707,661 | 102,537,835 | 67,000,000 |
| 1934 | 74,177,000 | 18,591,591 | 8,365,557 | 136,561,294 | 92,800,000 |
| 1935 | 119,295,000 | 21,291,235 | 3,970,347 | 191,645,888 | 102,800,000 |
| 1936 | 224,929,000 | 25,562,571 | 1,605,753 | 275,443,818 | 103,000,000 |
| 1937 | 292,681,000 | 45,178,069 | 5,383,516 | 335,958,553 | 125,120,000 |
| 1938 | 286,882,000 | 17,740,281 | 12,618,078 | 179,045,203 | 77,600,000 |

[1] Revised figures 1910–31; value unchanged from figures previously published. Revised figures from 1893 to 1909 are given in the following table.

[2] Crude and semicrude, some of which may be secondary aluminum. Imports are not separately recorded prior to July 1911, and imports from July 1911 through 1912 are general imports (adjusted with stocks in warehouses in 1912); 1913–38 are imports for consumption.

[3] Data not available on fluctuations in consumers' stocks, 1910–38, and in producers' stocks, 1910–28. Withdrawals from producers' stocks totaled 7,873,800 pounds in 1933, 52,158,260 in 1934, 55,030,000 in 1935, 26,558,000 in 1936, and 3,483,000 in 1937; additions to producers' stocks totaled 29,074,200 pounds in 1929, 95,303,700 in 1930, 70,683,000 in 1931, 38,948,000 in 1932, and 112,959,000 in 1938.

[4] Data not available.

[5] Not separately recorded prior to July 1917.

[2] Hollowell, R. D. T., Secondary Aluminum and Its Alloys: Am. Met. Market, vol. 46, No. 32, Feb. 17, 1939, p. 5.

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*Production of primary aluminum in the United States, 1893–1909*

| Year ending Aug 31— | Pounds | Year ending Aug. 31—Con. | Pounds |
|---|---|---|---|
| 1893 | 216, 000 | 1903 | 6, 636, 000 |
| 1894 | 494, 000 | 1904 | 8, 100, 000 |
| 1895 | 501, 000 | 1905 | 10, 810, 000 |
| 1896 | 1, 002, 000 | 1906 | 14, 125, 000 |
| 1897 | 2, 371, 000 | Sept. 1–Dec. 31, 1906 | 5, 469, 000 |
| 1898 | 2, 993, 000 | Year ending Dec. 31— | |
| 1899 | 3, 262, 000 | 1907 [1] | 16, 325, 000 |
| 1900 | 5, 062, 000 | 1908 [1] | 10, 679, 000 |
| 1901 | 5, 738, 000 | 1909 [1] | 29, 081, 000 |
| 1902 | 5, 763, 000 | | |

[1] Revised figures; value unchanged from figures previously published.

## CONSUMPTION

In 1938 the apparent domestic consumption of primary aluminum decreased 47 percent and recovery of secondary aluminum 38 percent compared with 1937. From 1934 to 1938 production of secondary aluminum was equivalent to 45 percent of the apparent consumption of primary metal.

The recession in industrial activity in 1938 caused the lowest consumption of aluminum in any year since 1934, but the marked upturn in business during the closing months of 1938 indicates increased consumption in 1939. The aircraft industry, one of the large users of aluminum, enjoyed a high rate of activity during 1938 and anticipates the greatest year in its history in 1939. Aluminum alloys, because of their strength, durability, and lightness, long have played a large part in the construction of airplane engines and bodies. Manufacturing facilities of American airplane firms were being expanded rapidly late in 1938 to meet the increased demands for aircraft from the United States Government, foreign countries, and commercial air lines. Other types of transportation, such as the automobile, bus,[3] railroad,[4] street-car, and ship [5] industries used large quantities of the metal in 1938 and may consume an even greater tonnage in 1939.

In the mining industry aluminum was used in 1938 for mine skips and cages and for portable tools, such as drills, car loaders, mine cars, hand shovels, power-shovel dippers, and dragline booms.[6] Aluminum is used for chemical equipment because it resists corrosion and has little or no effect on the color of materials processed in it.[7] Aluminum paint is used widely on weather-exposed and interior steel surfaces and on steel products.[8] Since the founding of the industry in 1888 the uses of aluminum have expanded extensively.

## PRICES

The price for 99-percent-plus pure virgin ingot aluminum, delivered, based on open-market quotations in New York, remained unchanged at 20 cents per pound, carload lots, throughout 1938. Quotations

[3] James, D. R., Aluminum Saves 1,680 Lb. in White Bus Body: Iron Age, vol. 142, No. 6, Aug. 11, 1938, pp. 28–31.

[4] Woollen, A. H., Aluminum Alloys in the Railroad Industry: Metals and Alloys, vol. 10, No. 1, January 1939, pp. 1–7.

[5] Hughes, W. R. N., Aluminum and Its Alloys with Particular Reference to Their Use in Warships: Paper presented before the Inst. Naval Architects, London, Apr. 8, 1938.

[6] Chesley, J. O., New and Growing Uses for Aluminum: Min. and Met., vol. 19, No. 382, October 1938, pp. 431–435.

[7] Fahrney, H. J., Aluminum Equipment: Chem. and Met. Eng., vol. 45, No. 11, November 1938, pp. 594–596.

[8] Fitch, G. H., Aluminum Paint: Steel, vol. 103, No. 17, Oct. 24, 1938, pp. 64–66, 75.

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for smaller lots down to 1 ton demanded a ½-cent premium and for less-than-ton lots a 1-cent premium. In London the domestic quotation for aluminum ingot was reduced on July 21, 1938, from £100 per long ton, less 2 percent delivered, to £94, net cash in 30 days, and the export price was cut from £100 to £90 per metric ton. However, on March 23, 1939, the export price was advanced to £95 per metric ton. European prices for aluminum ingot on December 31, 1938, were (converted in American money): 19.5 cents per pound in the United Kingdom, 24.2 cents in Germany, and 16 cents in France.[9] According to Metal Statistics 1939, dealers' 1938 buying prices per pound in New York for principal grades of domestic aluminum scrap averaged 7.58 cents for cast aluminum and 13.18 cents for new aluminum clips. The average selling price of remelted metal, 98½- to 99-percent grade, was 18.40 cents and of No. 12 alloy, No. 2 grade, 14.91 cents.

## FOREIGN TRADE

Imports of crude and semicrude aluminum were 61 percent less in 1938 than in 1937 and exports 134 percent higher. Crude and semicrude metal imports accounted for 10 percent of the apparent consumption of primary aluminum in 1938. Of these imports (8,870 short tons), 2,888 tons came from Norway, 2,647 from France, 1,424 from Switzerland, 1,216 from Canada, and 432 from the United Kingdom. The value of imports of aluminum manufactures decreased 31 percent and that of exports 7 percent. Of the crude and semicrude metal exported in 1938 (6,309 short tons), 2,221 tons went to Germany, 1,118 to the United Kingdom, 1,000 to Switzerland, 927 to Japan, 565 to the U. S. S. R., and 274 to Canada.

*Aluminum imported for consumption in the United States, 1936–38, by classes*

| Class | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Crude and semicrude: | | | | | | |
| Crude form, scrap, alloy, etc | 25,158,541 | $4,072,634 | 44,701,669 | $6,770,400 | 17,511,819 | $2,430,828 |
| Plates, sheets, bars, rods, circles, squares, etc | 404,030 | 92,327 | 476,400 | 112,139 | 228,462 | 60,566 |
| | 25,562,571 | 4,164,961 | 45,178,069 | 6,882,539 | 17,740,281 | 2,491,394 |
| Manufactures: | | | | | | |
| Leaf (5½ by 5½ inches) | (1) | 95,798 | (1) | 67,979 | (1) | 17,361 |
| Powder in leaf (5½ by 5½ inches) | (2) | 976 | (2) | 212 | | |
| Bronze powder and powdered foil | 478,043 | 173,780 | 295,299 | 124,276 | 186,418 | 77,425 |
| Foil less than 0.006 inch thick | 1,879,389 | 655,477 | 2,724,550 | 996,513 | 1,831,309 | 734,176 |
| Table, kitchen, and hospital utensils, and other similar hollow ware | 77,509 | 46,805 | 86,114 | 48,815 | 37,129 | 23,747 |
| Other manufactures | (3) | 43,467 | (3) | 57,266 | (3) | 34,915 |
| | (3) | 1,016,303 | (3) | 1,295,061 | (3) | 887,624 |
| Grand total | (3) | 5,181,264 | (3) | 8,177,600 | (3) | 3,379,018 |

[1] 1936: 43,260,596 leaves; 1937: 29,279,568 leaves; 1938: 8,389,969 leaves; equivalent in pounds not recorded.
[2] 1936: 177,916 leaves; 1937: 54,150 leaves; equivalent in pounds not recorded.
[3] Quantity not recorded.

[9] Anderson, Robert J., Long-Term Prices of Aluminum: Metallurgia, vol. 19, No. 112, February 1939, pp. 142-146.

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*Aluminum exported from the United States, 1936–38, by classes*

| Class | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Crude and semicrude: | | | | | | |
| Ingots, scrap, and alloys | 953,546 | $129,808 | 4,719,034 | $967,342 | 9,670,398 | $1,860,796 |
| Plates, sheets, bars, strips, and rods | 652,207 | 252,016 | 664,482 | 293,453 | 2,947,680 | 2,050,995 |
| | 1,605,753 | 381,824 | 5,383,516 | 1,260,795 | 12,618,078 | 3,911,791 |
| Manufactures: | | | | | | |
| Tubes, moldings, castings, and other shapes | 901,584 | 318,287 | 588,960 | 279,361 | 576,377 | 313,758 |
| Table, kitchen, and hospital utensils | 554,961 | 301,051 | 765,810 | 411,864 | 672,290 | 364,240 |
| Foil | (1) | (1) | 422,850 | 121,269 | 144,999 | 66,771 |
| Aluminum and aluminum bronze powder | (1) | (1) | 316,482 | 114,760 | 82,232 | 33,944 |
| Other manufactures of aluminum | (2) | 608,166 | (2) | 755,165 | (2) | 793,543 |
| | (2) | 1,227,504 | (2) | 1,682,419 | (2) | 1,572,256 |
| Grand total | (2) | 1,609,328 | (2) | 2,943,214 | (2) | 5,484,047 |

[1] Not separately recorded.
[2] Quantity not recorded.

## TECHNOLOGIC DEVELOPMENTS

The increasing use of bauxite as an adsorbent for the percolation filtration of paraffin-base oils is based largely upon its property of indefinite revivification without substantial degradation in adsorptive power. The effect of continued revivification upon both the decolorizing value and the "solvent" action of bauxite is discussed by Hubbell and Ferguson.[10] The specifications for bauxite to be used in oil refining comprise high capacity for removing color bodies and other impurities from lubricating oil, high resistance to abrasion, and a high inherent structural strength, including the ability to resist the disintegrating action of steam.

The Bureau of Mines has developed a process for the recovery of alumina, potassium sulfate, and some excess sulfuric acid from alunite [11] derived from the Marysvale (Utah) region.[12] Briefly, the alunite is sintered with boric acid and then leached with water to remove the potash and excess boric oxide, which are separated by brine flotation. The alumina is recovered by sulfuric acid leaching of the water-insoluble residue from the sinter and is precipitated electrolytically from the aluminum sulfate solution. Among the recent United States patents for the production of alumina are Nos. 2,123,650 and 2,127,504, on the treatment of clays, bauxite, etc., and Nos. 2,119,551[13] and 2,134,793, on the treatment of alunite, etc. A loan of $50,000 has been authorized by the Reconstruction Finance Corporation to Aluminum, Inc., Marysvale, Utah, for completion of a plant using the last of these patents.

[10] Hubbell, R. H., Jr., and Ferguson, R. P., Revivification Characteristics of Bauxite Used in Percolation Filtration: Presented at 19th Ann. Meeting, Am. Petrol. Inst., Chicago, Nov. 18, 1938.
[11] Koster, J., Knickerbocker, R. G., Fox, A. L., and Perry, P. R., Recovery of Potassium Sulfate and Alumina from Alunite by Fusion with Boric Acid; Progress Reports—Metallurgical Division, No. 30, Electrometallurgical Investigations: Bureau of Mines, Rept. of Investigations 3438, 1939, 15 pp.
[12] Callaghan, Eugene, Preliminary Report on the Alunite Deposits of the Marysvale Region, Utah: Geol. Survey Bull. 886-D, 1938, pp. 91–134.
[13] Light Metals, Alunite—A New Source of Aluminum: Vol. 2, No. 14, March 1939, p. 115.

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A recent report describes a process whereby ferruginous bauxite is treated with an excess of sulfur at high temperature and the resultant sulfides are chlorinated to yield aluminum chloride for use in the aluminum industry.[14]

The Carborundum Co. has announced a process for casting fused alumina refractories without a bond. A boroaluminate with a hardness of 7 to 7.5, high electrical resistance, and low thermal expansion is now being produced. In addition the company has devised a thermal microscope to study abrasive and refractory materials at temperatures above 2,000° C.[15]

The black appearance of aluminum utensils used in hot, slightly alkaline tap water has been found to be due to a purely optical phenomenon caused by a submicroscopic etching of the surface. As there is no superficial coating, corrosion resistance is unchanged. The etched surface has no hygienic or other disadvantages.[16]

Steel can be protected from corrosion by spraying, plate rolling, hot-dip plating, or calorizing aluminum on its surface.[17] The formation of the brittle compound $FeAl_3$ on plated steel can be avoided by the addition of a little silicon to the aluminum and by increasing the nitrogen and oxygen content of the steel. Aluminum can be deposited on iron and copper in a reducing atmosphere containing aluminum chloride gas at a temperature of 750° to 1,100° C. by the Martin process.[18]

The story of the production and uses of aluminum and its products is depicted in two motion-picture films recently produced by the Bureau of Mines in cooperation with the Aluminum Co. of America.

## WORLD BAUXITE AND ALUMINUM INDUSTRIES

### BAUXITE PRODUCTION

World production of bauxite in 1938 advanced slightly from the previous record established in 1937. The 1938 output is estimated as 3,850,000 metric tons, an increase of 5 percent over 1937. The principal producing countries, in the probable order of importance, were: France, Hungary, British Guiana, Yugoslavia, Italy, Surinam, the United States, the U. S. S. R., and Netherland India. Estimates for 1938 indicate that British Guiana increased its bauxite production approximately 51 percent, Hungary 20 percent, the U. S. S. R. 17 percent, Netherland India 16 percent, and Yugoslavia 12 percent.

[14] Fink, Colin G., and de Marchi, V. S., Beneficiating Ferruginous Bauxite Through Chlorination: Trans. Electro-chemical Soc., vol. 74, October 1938, pp. 469–494.
[15] Tone, Frank J., The Quest For Hard Materials: Ind. and Eng. Chem., vol. 30, No. 2, February 1938, pp. 241–242.
[16] Fischer, J., and Geller, W., The Blackening of Aluminum by Hot Tap Water: Ztschr. Metallk., vol. 30, No. 6, June 1938, pp. 192–195.
[17] Hoff, H., Aluminum as a Surface Protection for Steel: Stahl u. Eisen, vol. 58, No. 21, May 26, 1938, pp. 565–568.
[18] Steel, Metallic Coatings: Vol. 102, No. 25, June 20, 1938, pp. 60–65.

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*World production of bauxite, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia: | | | | | |
| New South Wales | 161 | 111 | | 6,793 | (1) |
| Victoria | 970 | 1,064 | 752 | 1,097 | 1,341 |
| Brazil [2] | | | 7,000 | 8,770 | 12,928 |
| British Guiana [2] | 51,417 | 113,290 | 172,884 | 305,533 | (1) |
| Czechoslovakia | | | | 846 | (1) |
| France | 528,400 | 512,850 | 649,500 | 688,200 | 682,440 |
| Germany | 6,560 | 8,547 | 12,425 | 18,212 | (1) |
| Greece | | 9,489 | 129,898 | 137,412 | (1) |
| Hungary | 184,991 | 211,079 | 329,091 | 451,576 | 540,717 |
| India, British | 18 | 7,758 | 3,702 | 15,393 | (1) |
| Indochina | | | 30 | 7,000 | (1) |
| Italy | 131,266 | 170,064 | 262,246 | 386,495 | 383,000 |
| Netherland India | | 16,708 | 133,731 | 198,970 | (1) |
| Portuguese East Africa | | 30 | 29 | | (1) |
| Rumania | 1,458 | 6,218 | 10,829 | 10,701 | (1) |
| Surinam (Dutch Guiana) | 103,338 | 112,682 | 234,845 | 392,447 | 371,632 |
| Unfederated Malay States: Johore | | | 37 | 19,305 | (1) |
| U. S. S. R. | 61,000 | 132,000 | 203,200 | [3] 230,000 | (1) |
| United Kingdom: Northern Ireland | 58 | | | | (1) |
| United States [4] | 172,080 | 251,341 | 388,945 | 446,046 | 329,015 |
| Yugoslavia | 84,828 | 216,197 | 292,174 | 354,233 | 396,368 |
| | 1,327,000 | 1,769,000 | 2,831,000 | 3,679,000 | (1) |

[1] Data not available. [2] Exports. [3] Estimated. [4] Dried bauxite equivalent.

## ALUMINUM PRODUCTION

The world production of aluminum in 1938 exceeded the 1937 record by approximately 17 percent. Production in 1938 is estimated as 561,800 metric tons. Germany took the lead as the foremost producer in 1938, increasing its output approximately 27 percent over 1937, whereas the United States, leader in 1937, decreased its output 2 percent. Japan increased its output 44 percent over 1937, Canada 32 percent, France 25 percent, the United Kingdom 24 percent, Norway 22 percent, the U. S. S. R. 20 percent, Switzerland 17 percent, and Italy 13 percent. The world's capacity for producing aluminum is expected to reach 840,000 tons by 1940.[19]

*World production of aluminum, 1934–38, by countries, in metric tons*

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Canada | 15,800 | 21,400 | 26,200 | 41,700 | [1] 55,000 |
| France | 15,100 | 22,000 | 29,700 | 34,500 | 43,000 |
| Germany | 37,200 | 70,800 | 97,200 | 127,200 | 161,100 |
| Austria | 2,100 | 2,200 | 3,000 | 4,000 | [1] 4,500 |
| Hungary | | 300 | 800 | 1,000 | 1,500 |
| Italy | 12,800 | 13,800 | 15,900 | 22,900 | 25,800 |
| Japan | 700 | 4,000 | [1] 6,700 | [1] 9,000 | [1] 13,000 |
| Norway | 15,300 | 15,000 | 15,400 | 23,000 | 28,000 |
| Spain | 1,200 | 1,200 | 600 | | [1] 800 |
| Sweden | 300 | 1,800 | 1,800 | 1,800 | 1,800 |
| Switzerland | 8,200 | 11,700 | 13,400 | 24,000 | 28,000 |
| U. S. S. R. | 14,400 | 25,500 | 30,000 | 40,000 | 43,900 |
| United Kingdom | 12,900 | 15,100 | 16,300 | 19,400 | 24,000 |
| United States | 33,600 | 54,100 | 102,000 | 132,800 | 130,100 |
| Yugoslavia | | | | 200 | [1] 1,300 |
| | 169,600 | 258,900 | 359,000 | 481,500 | [1] 561,800 |

[1] Estimated production.

[19] Anderson, Robert J., World Capacity for Aluminum Production: Metallurgia, vol. 19, No. 110. December 1938, pp. 65–68.



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## ALUMINUM CONSUMPTION

According to the Metallgesellschaft world consumption of aluminum in 1937 totaled 501,700 metric tons, a 26-percent increase over 1936. Europe consumed 63 percent of the total. The apparent consumption of the seven largest users of aluminum in 1938 (partly estimated) was as follows: Greater Germany 161,000 tons, the United States 81,213, the United Kingdom 66,000, the U. S. S. R. 56,000, Japan 40,000, France 30,000, and Italy 28,000. The United States was the only large world consumer to show a decline (47 percent) in 1938.

## REVIEW BY COUNTRIES

*Brazil.*—Bauxite reserves of the Poços de Caldas Plateau,[20] chiefly in Minas Geraes, are conservatively estimated at 20,000,000 metric tons. The Companhia Geral de Minas, the principal producer, washes, crushes, dries, pulverizes, and packs in bags the bauxite that it exports to Buenos Aires, Argentina, for the manufacture of aluminum sulfate. The ore shipped averages 60 to 65 percent $Al_2O_3$, 1 to 2 percent $SiO_2$, 4 to 6 percent $Fe_2O_3$, 1 to 2 percent $TiO_2$, and 28 to 31 percent combined water. However, about 90 percent of the Poços de Caldas ore averages only 54 to 60 percent $Al_2O_3$, 2 to 5 percent $SiO_2$, 7 to 10 percent $Fe_2O_3$, 1 to 2 percent $TiO_2$, and 28 to 32 percent combined water. The large bauxite deposits near Ouro Preto, also in Minas Geraes, are soon to be mined by the Companhia Electro-Chimica Brasileira.

Favorably located bauxite deposits are being prospected in the state of Rio de Janeiro near Itatiaya,[21] which is close to a railroad. The M. C. Fonseca e Companhia, operating the Muquy deposits,[22] João Pessoa County, Espirito Santo, recently began to ship crushed ore by rail to Rio de Janeiro. There are large reserves of bauxite in five other States in Brazil, but they have not been developed. In Maranhão about 10,000,000 tons of bauxite occur on Trauhyra Island and along both banks of the Gurupy River.

Although railroads are near some of the Brazilian bauxite deposits, transportation is a problem because of the shortage of freight cars and the differences in gage of track. Thus, the low cost of mining ($0.55) and processing ($2.42) is offset by the high cost of freight and loading, and the total cost of delivering processed bauxite, f. o. b. Santos, is about $7 per metric ton. The ore sells for $8.80 to $11.00 per ton, f. o. b. Santos, and $6.60 to $9.90, f. o. b. Rio de Janeiro.

*British Guiana.*—The 1938 production of the Demerara Bauxite Co., Ltd., in the Christianburg-Akyma field, totaled 454,549 metric tons of bauxite containing 60 percent $Al_2O_3$ and 117,502 tons of lower-grade ore (mostly 30 to 50 percent $Al_2O_3$). The Berbice Co., Ltd., affiliated with the American Cyanamid & Chemical Corporation, obtained a concession on 4,000 acres of bauxite land about 125 miles up the Berbice River from New Amsterdam. Other foreign bauxite holdings of the chemical concern are in the Para district, Surinam. A recent bulletin [23] on the British Guiana bauxite deposits describes

[20] Pinto, M. S., Bauxita em Poços de Caldas: Dept. Nacional da Producção Mineral Bull. 22, 1938.
[21] Pinto, M. S., Descoberta de Ocorrência de Bauxita no Itatiaya: Mineração e Metallurgia, vol. 3, No. 15, 1938, p. 183.
[22] Bromirsky, A., Bauxita em Muquy, Espirito Santo: Mineração e Metallurgia, vol. 2, No. 7, May-June 1937, p. 45.
[23] Bishopp, D. W., Memorandum on the Occurrence of Bauxite in British Guiana: Geol. Survey of British Guiana Bull. 8, Georgetown, 1938, pp. 49–54.

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a fairly reliable field test, based upon loss on ignition at a red heat, to distinguish gibbsitic bauxite from lithomarge or other indurated earths and clays.

*British India.*—The Aluminium Production Co. (India), Ltd., (Indian capital) plans to construct an aluminum-reduction works near Asansol, Bengal, and a rolling mill at Belur. Coal is available near Asansol, and bauxite may be obtained from the Ranchi district, Bihar and Orissa. Aluminium, Ltd. (Canadian), and the British Aluminium Co., Ltd., jointly propose to erect similar facilities in India.

*Canada.*—Exports as well as production of aluminum established a new record in Canada in 1938. Exports totaled 58,717 metric tons compared with 44,000 tons in 1937. Of the 1938 exports, 30,765 tons went to the United Kingdom, 14,105 to Japan, 5,621 to Germany, 1,934 to the U. S. S. R., 1,620 to Sweden, 1,518 to China, 1,013 to the United States, and 890 to Norway. Some shipments to Japan were sent via Portland, Maine. Canadian imports of bauxite, alumina, and cryolite increased from 282,093 metric tons in 1937 to 339,949 in 1938. British Guiana bauxite comprised 84 percent of the total imports.

Expansion of the aluminum-reduction and alumina plants of the Aluminum Co. of Canada at Arvida, Quebec, was completed in 1938. Fabrication facilities are to be extended at Toronto to provide for more products used in the aircraft industry. In 1938 the hydroelectric properties and power sites on the Saguenay River belonging to Alcoa Power Co., Ltd., were sold to the Aluminum Power Co., Ltd., a subsidiary of Aluminium, Ltd.

*China.*—The Hsin Chung Kungssu (Japanese) has obtained permission from the Kailan Mining Administration to exploit bauxite deposits in North China. Large deposits are said to occur in Kaiping, Tzechwan, and Poshan.

*France.*—The capacity of French aluminum-reduction plants is to be expanded from 45,000 to 55,000 metric tons in 1939.[24]

The capacity of the alumina plant at La Barasse was expanded in 1938. Of 13 companies in France, 4 produce most of the bauxite output.[25] The underground and open-pit mining methods employed in the bauxite mines were recently described.[26]

Bauxite exports totaled 291,684 tons in 1938 (301,601 in 1937), of which the United Kingdom received 187,963 tons, Germany 84,075, and Sweden 13,923. Alumina exports totaled 21,770 tons (27,158 in 1937), of which Switzerland received 16,026 and Norway 5,264. Exports of crude and semicrude aluminum increased from 9,031 tons in 1937 to 16,560 in 1938.

*French Guinea.*—The bauxite deposits on the isle of Tamara in the Los Islands group, estimated to contain 20,000,000 tons, were developed in 1938 by Société Anonyme des Bauxites du Midi (Canadian). A geological survey of the vast bauxite resources on the mainland of French Guinea[27] is to be made.

[24] d'Auvigny, M. Henri, The French Aluminum Industry: Light Metals, vol. 1, No. 10, November 1938, pp. 351–353.

[25] Bureau of Mines, Mineral Trade Notes: Vol. 7, No. 4, Oct. 20, 1938, pp. 2–3.

[26] Nicholas, W. L. J., Bauxite Mining in France: Mine and Quarry Eng., London, vol. 3, No. 5, May 1938, pp. 175–183.

[27] Goloubinow, R., Les bauxites de Tougue: French West Africa Service du Mines, Bull. 1, 1938, pp. 77–80. Chételat, E., Le Modelé latéritique de l'ouest de la Guinée Française: Rev. géog. physique et géol. dynamique (Paris), vol. 11, No. 1, 1938, 125 pp. Lapperent, J., Laterites de L'Afrique Occidentale: Compt. rend. July 18, 1938.

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*Germany.*—Although the largest producer of aluminum in 1938, Germany had to import an additional 14,521 metric tons of crude metal (only 3,645 tons in 1937) to serve domestic requirements. The import duty on aluminum was lifted until March 31, 1939. Exports of crude metal increased from 1,334 to 2,831 tons, but those of fabricated metal decreased from 15,920 to 15,096 tons.

The State-owned Vereinigte Aluminiumwerke A. G. produced approximately three-fourths of the total German aluminum output at Lautawerk, Toging-am-Inn, and Grevenbroich (Niederrhein); the balance was produced by Aluminiumwerke G. m. b. H. at Bitterfeld and Aluminium G. m. b. H. at Rheinfelden (Rhein). In 1938 the capacity of the Rheinfelden plant was extended to 23,000 tons annually, a new aluminum-refining plant was constructed at Lautawerk, and expansion of the Austrian aluminum-reduction plants at Steeg and Lend was contemplated. Reports state that in 1939 approximately 8,000 tons of alumina will be produced from clay at the large-scale experimental plant built at Lippe. Although the recovery of alumina from clay is costly, this source of supply can be relied upon in an emergency.

Bauxite imports dropped from 1,313,152 tons in 1937 to 1,184,647 in 1938. Of the 1938 imports, 363,256 tons came from Hungary, 348,068 from Yugoslavia, 192,668 from Netherland India, 96,593 from Italy, 92,272 from France, 84,796 from Greece, and 6,994 from Denmark (probably cryolite). Imports from Netherland India increased 39 percent compared with those in 1937, whereas imports from Hungary, Yugoslavia, and Italy decreased substantially. Bauxite deposits in the Laussa Valley of German Austria may be mined in the future.

*Hungary.*—The large bauxite production of Hungary (reported at 540,717 metric tons in 1938) is derived from two open-pit mines worked near Gánt by Aluminiumérc, Bánya és Ipar R. T. of Budapest. Here a continuous layer of red bauxite, from 50 to 100 feet thick, is underlain by an uneven surface of Triassic dolomite and overlain in part by Tertiary clay and limestone strata of varying thickness. Faults have been important in localizing the bauxite areas, having preserved them from recent erosion.[28] Another aluminum-reduction plant with an annual capacity of 1,000 tons is to be completed in 1939 near Totis by the Hungarian United Coal Mining Co., Ltd.

*Indochina.*—The bauxite produced in Indochina, probably derived from the Dragon mine in the Province of Lang-son, is exported to Japan.[29]

*Italy.*—The aluminum-reduction plant of the Società Alluminio Italiano (Canadian) at Borgofranco d'Ivrea will be expanded to an annual capacity of 4,000 tons in 1939. The capacity of synthetic cryolite and alumina plants at Porto Marghera also are to be increased. In 1938, Italy exported 75,386 metric tons of bauxite to Germany and 39,616 tons of alumina, chiefly to Switzerland and Germany. The Società Bauxiti Istriane (a Montecatini subsidiary) began mining bauxite near San Giovanni (Apulia), southern Italy. In recent years almost all the bauxite has come from Istria.

[28] Singewald, Quentin D., Bauxite Deposits at Gánt, Hungary: Econ. Geol., vol. 33, No. 7, November 1938, pp. 730–736.

[29] Génie civil, "Les nouvelles substances minérales exploitées en Indochine. La Bauxite: Paris, vol. 112, No. 10, March 1938, p. 214.

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*Japan.*—The nationalization of the electrical industry of Japan is expected to result in large extensions and consolidations in aluminum and magnesium production facilities. The Japan Aluminium Co. plans to increase aluminum output at its Takao plant from 6,000 to 8,000 metric tons, and construction has begun on a new reduction plant of 8,000 tons annual capacity at Beiron, Karenko City, East Taiwan.[30] With the financial backing of large Japanese industrial and power concerns and protection of the government, the Japan Light Metals Co. proposes to erect alumina and aluminum plants in several parts of Greater Japan. The proposals call for an alumina plant of 120,000-ton annual capacity at Shimizu and an aluminum-reduction works at Kambra, both in Shizuoka Prefecture. The Nitto Chemical Industrial Co. plans to utilize an aluminous phosphate ore from Manchuria in the production of aluminum at Hachinohe, northeastern Japan. Alumina will be extracted from the ore by treatment with sulfuric acid and ammonia gas.

The Japanese producers of aluminum[31] in 1938, in their probable order of importance were: Japan Aluminium Co., Takao, Formosa; Japan Electric Industry Co., Omachi and Yokohama; Sumitomo Aluminium Reduction Co., Niihama; Nichiman Aluminium Co., Iwasemachi; Japan Soda Co., Ltd., Takaoka; and probably the Manchuria Light Metal Co., Fushun, Manchuria. Production is estimated at 13,000 tons compared with 9,000 tons in 1937. More than 21,500 tons of aluminum were exported to Japan in 1938 from Canada, Norway, Germany, and the United States, and consumption of domestic and imported primary and secondary metal probably exceeded 40,000 tons. In Northeastern Korea the Chochinko Hydro-electric Co. began constructing a 220,000-volt transmission line 100 kilometers long with aluminum cable, steel-reinforced.

*Netherlands.*—In 1938 the N. V. Aluminium Walswerken-en Persbedrijven (Canadian-Dutch) began to erect an aluminum rolling and extrusion plant at Utrecht, at the crossing of the projected Amsterdam-Rhine Canal and the new locks in the Old Rhine. The same interests also formed a company for the production of aluminum, but construction of the reduction plant has not yet started. Interests representing L'Aluminium Français S. A. (French) were denied the privilege of establishing a rival aluminum industry in the Netherlands. The increasing use of aluminum and the geographical position of the Netherlands as a distributing center are given as the reasons for creating the aluminum industry rather than the desire to satisfy the small local consumption (2,307 metric tons of crude and semicrude metal imported in 1938).

*Netherland India.*—The N. V. Nederlandsche-Indische Bauxiet Exploitatie Maatschappij (NIBEM) produced an estimated 230,000 metric tons of bauxite in 1938 on the island of Bintan, where construction was completed on a bauxite washing and drying plant and on an overhead cableway connecting it with the new bauxite deposits on the islands of Angkoet and Kojang.

Early in 1939 the N. V. Billiton Maatschappij, the parent concern of NIBEM, and the N. V. Gem. Mijnbouwmij Billiton sought capital to establish an aluminum industry in Netherland India. Preliminary plans call for the construction of an alumina plant, probably at

[30] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, p. 2.
[31] Anderson, Robert J. The Aluminum Industry of Japan: Min. Mag. (London), vol. 59, No. 2, August 1938, pp. 73–85.

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Palembang, Sumatra, near the Boekit Asem coal mines; an aluminum-reduction works on the east coast of Sumatra which can utilize the water powers of the Asahan River; and fabricating works in Java at Djokjasche.

*Norway.*—In 1938 imports of bauxite into Norway totaled 25,942 metric tons (40,474 in 1937) and of alumina, 43,738 tons (38,016 in 1937). Exports of crude aluminum increased from 21,503 tons in 1937 to 28,577 in 1938, of which 5,325 tons went to the United Kingdom, 5,014 to Japan, 3,190 to the U. S. S. R., 2,700 to Greater Germany, 2,610 to Sweden, 2,427 to the United States, and the rest chiefly to Denmark, Switzerland, Czechoslovakia, Belgium, and Brazil.

*Poland.*—An aluminum-reduction works is to be constructed near Sandomir.

*Surinam (Dutch Guiana).*—In 1938 the Surinaamsche Bauxite Maatschappij shipped 377,595 metric tons of bauxite from its mines at Moengo Hill on the Cottica River. Another bauxite property is to be developed by the company in 1939 in the Para district about 25 miles south of Paramaribo. Bauxite mined at Topibo Hill will be transported by narrow-gage railroad to a crushing, washing, screening, and drying plant to be constructed on the west bank of the Surinam River. Two rotary drying kilns are to be installed with a total capacity of 150 tons per hour. As heretofore, the company will pay a royalty of 12½ cents per ton on bauxite mined and contribute 10 cents per ton on each ton exported, for harbor and river maintenance.[32] The N. V. Billiton Maatschappij is investigating bauxite deposits in the Nassau Mountains and along the Government Railroad, 70 miles south of Paramaribo.

*Sweden.*—The AB. Swenska Aluminiumkompaniet, operating the aluminum-reduction works at Mânsbo, plans to establish an alumina plant in Sweden.

*Switzerland.*—The Neuhausen Co. (AIAG) increased its output in 1938 at Chippis and started producing aluminum of 99.99-percent purity. Outside of Switzerland the capacity of company plants was increased in Greater Germany and Italy, and an interest was obtained in a new aluminum-reduction works under construction in the United Kingdom. Its plants in France were handicapped by labor difficulties. The Lend (Austria) reduction works probably will be converted into an independent subsidiary, as was done at the Rheinfelden (Germany) works.

In 1937 the Aluminum Cartel, the Alliance Aluminium Cie. (Basel), liquidated its available stock and abolished output curtailment measures. Since then European demand for aluminum has been greater than the supply.

*Unfederated Malay States: Johore.*—Bauxite mined at the Pasir mine, Batu Pahat, is exported to Japan by the Ishiwara Sangyo K. K. The area in the vicinity of Kuantan, Tanjong, and Changkat Pandan in Pahang is being prospected for bauxite.

*U. S. S. R.*—In 1938 the Volkhov and Dnepr aluminum-reduction plants produced about 44,000 metric tons of metal compared with 40,000 in 1937. The alumina process at the Dnepr works was modified, and preparations were made for the utilization of nepheline at the Tikhvin alumina works. Improvements were made in the

[32] American Metal Market, New York, vol. 45, No. 103, May 27, 1938, p. 5.

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recovery of alumina from bauxite (70-percent recovery) and in the consumption of electric energy per ton of aluminum produced. In 1939 the Government plans to invest considerable capital in the industry and obtain higher efficiency in the use of raw material, power, and labor. The new alumina and reduction plants at Kamensk are scheduled to start operations in 1939. A modern, closed-type reduction furnace, with self-baking electrode operating on 50,000 amperes, will be employed.[33] Before 1942 new aluminum works are to be constructed in Kandalaksha and at Rybinsk, Siberia.

The bauxite deposits in the North and South Urals and near Tikhvin produced an estimated 270,000 tons in 1938. New bauxite discoveries are reported in the Bashkiria Republic, at Aktiubinsk east of the Urals, and near Tula, Central Russia. The All-Union Institute of Heat Technology reports that 23 to 40 percent alumina could be recovered from Soviet lignite ashes.

*United Kingdom.*—Imports of crude aluminum and its alloys into the United Kingdom totaled 46,996 tons in 1938 compared with 32,079 in 1937. Of the 1938 imports, 30,902 tons came from Canada, 9,699 from Switzerland, and 5,434 from Norway. Imports of bauxite increased from 222,953 tons in 1937 to 252,925 in 1938.

During 1938 the British Aluminium Co., Ltd., continued its program announced in 1937 of expanding alumina and aluminum production capacity. The alumina plant at Burntisland, Scotland, was completed and is working at full capacity to meet demands of the new reduction furnaces at Lochaber, Scotland. The alumina plant at Newport, Wales, was nearly completed, and fabrication facilities at Banbury, England, are being extended considerably. Aluminium, Ltd., established a research laboratory at Banbury in 1938. British, Canadian, and Swiss interests formed the South Wales Aluminium Co., Ltd., which began to construct an aluminum-reduction plant early in 1939 at Resolven in the Neath Valley, Glamorganshire, South Wales.

*Yugoslavia.*—The capacity of the new reduction plant at Lozovac near Sibenik is to be increased to 2,000 tons of aluminum annually. Most of the metal has been exported to the United Kingdom. Another alumina plant (in addition to the one at Ljubljana) is under construction at Lozovac by Aluminiumfabrik A. G. In 1938 the Dalmacia-Bauxit Co. of Split began to work a new bauxite deposit at Donja Suhaja, near Bosanska Krupa; and two new bauxite mining companies, the Pan Bauxit Co. (German) and the Ugrovaca Mining Co. of Zagreb (Swiss), began exploration work in the Siroka Breg Mountains near Mostar.

[33] Behr, A., Development and Research in the Russian Aluminum Industry: Metallurgia, vol. 19, No. 112, February 1939, pp. 137–138.

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# MERCURY

By H. M. Meyer

## SUMMARY OUTLINE


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Normal international trade in mercury was hampered again in 1938 by the civil war in Spain, where the principal mercury reserves of the world are situated. Although the war continued to restrict production in Spain, world supplies of metal were more than ample for consumption requirements even though demand in Germany and the United Kingdom surpassed the high rates attained in 1937. Italian production duplicated the record rate achieved in 1937, but exports dropped from 67,075 flasks in 1937 to 55,327 in 1938. Exports from Spain were reported to have increased from 28,357 flasks in 1937 to approximately 40,000 in 1938, so indications are that Spain supplied a larger share of world requirements in 1938 than in 1937. Consumption in the United States was markedly lower in 1938 with production only 9 percent above the 1937 rate and imports 88 percent less than in 1937. Another source of foreign metal for consumption, which is not revealed by import statistics, is the mercury produced in this country from concentrates received from Mexico. Metal from this source totaled more than 2,600 flasks in 1938. In addition, actual consumption of mercury in the United States probably was higher than available figures indicate owing to a reduction in consumers' stocks. Consumers' stocks are believed to have been built up considerably during the late months of 1936 and early in 1937, when a world shortage of metal, which never materialized, was threatened.

The year 1938 was marked by the strenuous efforts of the Rebel forces in Spain to win possession of the Almaden mine and by the stubborn resistance of the Loyalist forces. The stiffening of prices early in 1939 probably was due partly to additional demands for mercury caused by world-wide fear of war. It also suggests that the defeat of the Loyalist Government forecasts closer cooperation between Italian and Spanish producers in regard to the marketing of supplies rather than a return to the competitive methods that prevailed before the formation of Mercurio Europeo.

Although to most domestic producers, 1938 was unsatisfactory, the situation at the end of the year was much more favorable than at the beginning. In January 1938 consumption was low and prices were falling. In December, on the contrary, demand was improving and prices were rising.



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Notes on advances in the metallurgy of quicksilver since the World War were published by Ransome [1] early in 1939.

Wehrly [2] has prepared an article that contains much information on uses of mercury. Regarding specifications for mercury, Wehrly states:

The relative low tenor of cinnabar ores—8 percent in Spain, ½ to 2 percent in Italy, 1 percent in Mexico, and less than ½ percent in the United States—precludes transportation to a custom smelter, hence the mine must be a complete unit. The only exception is a recent experiment in which hand-picked Mexican ore was sent to this country for reduction.

The quality of the mercury so produced is exceptionally pure. Random assays show well over 99.5 percent and as high as 99.9 percent with dirt and oil from the insides of the flask as the only mechanical impurities. It is peculiar that no standard has been set by the industry—a fact probably caused by this unusual degree of purity. The U. S. P. states that mercury should test at least 99.5 percent. One large user, who if he actually received such impure metal would reject it, calls for 95 percent. Conversely another company has set up specifications which cannot be met with commercial metal. Further purification is not necessary in the majority of cases, and mechanical cleaning will suffice. Commercial mercury is termed "prime virgin" and is packed in iron or steel flasks containing a net weight of 76 pounds (34.5 kilograms). Exceptional uses may require redistilled or triple-distilled mercury, in which latter case the purity exceeds 99.9 percent plus with a nonvolatile content of not over 0.002 percent. The redistilled type is sold in earthenware or glass jugs containing 5, 10 or 20 pounds.

United States Patent 2,119,231, issued May 31, 1938, covers a process for recovering mercury from antimony-bearing ores.

*Salient statistics of the mercury industry in the United States, 1934–38*

[Flasks of 76 pounds]

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Production.....flasks | 15,445 | 17,518 | 16,569 | 16,508 | 17,991 |
| Number of producing mines | 93 | 90 | 87 | 101 | 91 |
| Average price per flask: | | | | | |
| New York | $73.87 | $71.99 | $79.92 | $90.18 | $75.47 |
| London | $56.15 | $60.74 | $64.33 | $69.65 | $66.92 |
| Imports for consumption: | | | | | |
| Pounds | 774,564 | 593,904 | 1,374,652 | 1,437,712 | 179,522 |
| Equivalent flasks | 10,192 | 7,815 | 18,088 | 18,917 | 2,362 |
| Exports: | | | | | |
| Pounds | (1) | (1) | 19,980 | 34,485 | 54,161 |
| Equivalent flasks | (1) | (1) | 263 | 454 | 713 |
| Apparent new supply.....flasks | 25,400 | 25,200 | 34,400 | 35,000 | 19,600 |
| From domestic mines.....percent | 60 | 69 | 47 | 46 | 88 |
| Stocks in warehouses (bonded) at end of year flasks | 4,346 | 3,582 | 2,513 | 4,286 | 553 |

[1] Not separately classified for 1934–35.

## REPORT ON STRATEGIC MINERALS

A joint report on certain deficient strategic minerals was prepared by the staffs of the Geological Survey and the Bureau of Mines and published in February 1939. Because of the importance of strategic minerals and the interest in them, particularly at present, the text on mercury and two historical tables are quoted as follows:

*General.*—The normal annual consumption of mercury in the United States in recent years has ranged from 25,000 to 35,000 flasks of 76 pounds each, of which about half has been imported. Mercury is used in the manufacture of fulminate,

[1] Ransome, Alfred L., Quicksilver Metallurgy Today: Eng. and Min. Jour., vol. 140, No. 4, April 1939, pp. 46–49.

[2] Wehrly, Chas. S., Mercury Down the Ages Part 2: Chem. Ind., vol. 44, No. 3, March 1939, pp. 257–260.

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for detonating high explosives and fixed ammunition, for gold recovery by amalgamation, in drugs (calomel, corrosive sublimate, etc.), dental amalgam, antifouling paint for ship bottoms, storage batteries, barometers, etc. Substitutes for some of these purposes may be used, but none is known for the greater part of the consumption.

*Production, imports, exports, and apparent new supply of mercury in the United States, 1910–38, in flasks of 76 pounds*

| Year | Production | Imports for consumption | Exports | Apparent new supply | Year | Production | Imports for consumption | Exports | Apparent new supply |
|---|---|---|---|---|---|---|---|---|---|
| 1910 | 20,330 | 9 | 1,898 | 18,441 | 1925 | 9,053 | 20,580 | 201 | 29,432 |
| 1911 | 20,976 | 6,209 | 287 | 26,898 | 1926 | 7,541 | 25,634 | 114 | 33,061 |
| 1912 | 24,734 | 1,088 | 306 | 25,516 | 1927 | 11,128 | 19,941 | [1] | [2] 30,900 |
| 1913 | 19,947 | 2,259 | 1,125 | 21,081 | 1928 | 17,870 | 14,562 | [1] | [2] 32,300 |
| 1914 | 16,330 | 8,090 | 1,427 | 22,993 | 1929 | 23,682 | 14,917 | [1] | [2] 38,500 |
| 1915 | 20,756 | 5,551 | 3,328 | 22,979 | 1930 | 21,553 | 3,725 | [1] | [2] 25,200 |
| 1916 | 29,538 | 5,585 | 8,763 | 26,360 | 1931 | 24,947 | 549 | [3] 4,984 | 20,512 |
| 1917 | 35,683 | 5,138 | 10,636 | 30,185 | 1932 | 12,622 | 3,886 | [3] 214 | 16,294 |
| 1918 | 32,450 | 6,631 | 3,057 | 36,024 | 1933 | 9,669 | 20,315 | [1] | [2] 29,700 |
| 1919 | 21,133 | 10,495 | 8,987 | 22,641 | 1934 | 15,445 | 10,192 | [1] | [2] 25,400 |
| 1920 | 13,216 | 13,982 | 1,533 | 25,665 | 1935 | 17,518 | 7,815 | [1] | [2] 25,200 |
| 1921 | 6,256 | 10,462 | 388 | 16,330 | 1936 | 16,569 | 18,088 | 263 | 34,400 |
| 1922 | 6,291 | 16,697 | 287 | 22,701 | 1937 | 16,508 | 18,917 | 454 | 35,000 |
| 1923 | 7,833 | 17,836 | 314 | 25,355 | 1938 | 17,991 | 2,362 | 713 | 19,600 |
| 1924 | 9,952 | 12,996 | 205 | 22,743 | | | | | |

[1] Not separately classified for 1927-30 and 1933-35.
[2] Estimated by the Bureau of Mines.
[3] From a special compilation by the customs statistics section, Bureau of Foreign and Domestic Commerce.

*Sources.*—Mercury mining in the United States began in California about 1846, and for many years deposits in that State yielded all of the domestic production. Even though many deposits in other States have been productive (chiefly Texas, Oregon, and Nevada), the mines in California consistently ship more than those of any other State. For most of the years from 1850 to 1870, a single mine (New Almaden) yielded 70 to 90 percent of the output of California, which was almost the entire domestic production. Domestic production attained the annual maximum of 80,000 flasks in 1877, and from 1880 to 1919 it generally ranged from 20,000 to 35,000 flasks. Prior to 1919, domestic production usually yielded a surplus for export, but since then imports have generally been needed to meet consumption. During the last 5 years (1933–37) production and imports have been about equal. An import duty on mercury was first imposed in 1883, and since 1922 it has been 25 cents a pound or $19 a flask.

The principal mercury mineral is the sulfide, cinnabar, and the recovery processes are designed to extract mercury only, since mercury is rarely present in the ores of the other metals. As almost every mine is equipped with a recovery plant, metallic mercury is shipped direct to the market, and mine production tends to respond quickly to changes in price. The ore bodies have diverse shapes and sizes, but most of them are tabular and dip steeply into the earth. All mines yield some high-grade ore, but the steady decline in grade through the years has necessitated improvements in mining and treatment. Most of the ore now treated at domestic mines contains from 3 to 10 pounds of mercury per ton of ore.

Several efforts have been made to appraise the reserves of mercury in some Western States. One estimate made in 1931 indicated about 175,000 flasks in six States, but from 1931 to 1937, inclusive, nearly 115,000 flasks were produced. It is unusual to find blocked-out reserves in any mercury mine, and for this reason it is almost impossible to estimate mercury resources with any degree of accuracy. Three active districts in California and one in Nevada were studied by Federal geologists in 1938. A study of the history of production at numerous mines, taking into account their geologic features and environment, as well as prevailing technique and prices, indicates that dependable forecasts of production at several assumed prices can be made.

*Production from domestic mines.*—The latest summary of the mercury deposits of California (1918) records about 125 mines or groups of mines, as well as many more prospects, in 39 counties; practically all of the output, however, has been

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derived from seven counties. One mine (New Almaden) has yielded nearly half the total of the State, but it has been idle in recent years. The peak of production appeared in 1877, and the peaks for the six outstanding counties appeared between 1865 and 1881. Even though it cannot be stated that no new large deposits will be discovered, it appears unlikely that the output of domestic mines will approach again the record for 1877. Experience in most mines shows that the grade of ore treated has steadily declined and now rarely exceeds 10 pounds of Mercury to the ton. In many mines the tenor of most of the ore ranges from 3 to 5 pounds to the ton. Without the benefit of the tariff of 25 cents a pound, imposed in 1922, it is doubtful whether any mines in the State would be active.

*Mercury produced in the United States, 1910-38, by States*

[Flasks of 76 pounds]

| Year | California | Texas | Oregon | Nevada | Other States [1] | Total |
|---|---|---|---|---|---|---|
| 1910 | 16,985 | 3,276 | ---------- | 69 | ---------- | 20,330 |
| 1911 | 18,612 | 2,295 | ---------- | 69 | ---------- | 20,976 |
| 1912 | 20,254 | 1,964 | ---------- | 2,516 | ---------- | 24,734 |
| 1913 | 15,386 | 2,714 | ---------- | 1,623 | 224 | 19,947 |
| 1914 | 11,154 | 3,103 | ---------- | 2,062 | 11 | 16,330 |
| 1915 | 14,095 | 4,359 | [2] | 2,296 | 6 | 20,756 |
| 1916 | 20,768 | 6,223 | 299 | 2,169 | 79 | 29,538 |
| 1917 | 23,623 | 10,649 | 383 | 984 | 44 | 35,683 |
| 1918 | 22,366 | 8,340 | 693 | 1,030 | 21 | 32,450 |
| 1919 | 15,005 | 4,953 | 429 | 746 | ---------- | 21,133 |
| 1920 | 9,719 | 3,391 | 24 | 82 | ---------- | 13,216 |
| 1921 | 3,015 | [2] | [2] | [2] | 3,241 | 6,256 |
| 1922 | 3,360 | [2] | 2 | [2] | 2,929 | 6,291 |
| 1923 | 5,375 | [2] | [2] | [2] | 2,458 | 7,833 |
| 1924 | 7,861 | [2] | [2] | [2] | 2,091 | 9,952 |
| 1925 | 7,514 | [2] | ---------- | 532 | 1,007 | 9,053 |
| 1926 | 5,651 | [2] | ---------- | 194 | 1,696 | 7,541 |
| 1927 | 5,672 | [2] | 2,055 | 419 | 2,982 | 11,128 |
| 1928 | 6,977 | [2] | 3,710 | 2,867 | 4,316 | 17,870 |
| 1929 | 10,139 | [2] | 3,657 | 4,764 | 5,122 | 23,682 |
| 1930 | 11,451 | [2] | 2,919 | 3,282 | 3,901 | 21,553 |
| 1931 | 13,448 | [2] | 5,011 | 2,217 | 4,271 | 24,947 |
| 1932 | 5,172 | [2] | 2,523 | 474 | 4,453 | 12,622 |
| 1933 | 3,930 | [2] | 1,342 | 387 | 4,010 | 9,669 |
| 1934 | 7,808 | [2] | 3,460 | 300 | 3,877 | 15,445 |
| 1935 | 9,271 | [2] | 3,456 | 190 | 4,601 | 17,518 |
| 1936 | 8,693 | [2] | 4,126 | 211 | 3,539 | 16,569 |
| 1937 | 9,743 | [2] | 4,264 | 198 | 2,303 | 16,508 |
| 1938 | 12,277 | [2] | 4,610 | 336 | 768 | 17,991 |

[1] Includes, in addition to States shown as "[2]", Alaska, Arizona, Arkansas, Idaho, Utah, and Washington.
[2] Included with "Other States." Bureau of Mines not at liberty to publish figures separately.

Since 1897, several thousand flasks of mercury have been produced annually from a district of several square miles in area near Terlingua, Tex. Although several mines have been developed in this district, most of the production of about 137,000 flasks has come from one mine.

Mercury was discovered in Oregon as early as 1865, but the State did not become important as a producer of mercury until 1927. Since then, annual production has been fairly constant, and the number of sources has risen steadily. From a recent study of the deposits throughout the State, it appears that if present prices are maintained the current rate of production may be expected to continue for a decade or more.

Even though mercury is recorded widely in Nevada, most of the exploration is confined to 32 districts; of these, only 7 have yielded a product and 2 have yielded well over one-half of the total production. Except in times of high prices, production is small.

Since 1910, annual production has responded closely to price, but the highs and lows of production follow those of price by a year or two.

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*Expected production of mercury at assumed index prices*

| *Assumed index price per flask mercury, dollars* | | *Flasks* |
|---|---|---|
| 50 | First year | 6,000–8,000 |
| 50 | Second year | 8,000–10,000 |
| 50 | Third year | 8,000–10,000 |
| 65 | First year | 12,000–15,000 |
| 65 | Second year | 15,000–18,000 |
| 65 | Third year | 12,000–16,000 |
| 85 | First year | 18,000–22,000 |
| 85 | Second year | 22,000–25,000 |
| 85 | Third year | 22,000–25,000 |
| 100 | First year | 20,000–22,000 |
| 100 | Second year | 25,000–30,000 |
| 100 | Third year | 25,000–30,000 |

*Technologic progress.*—Technologic advance in the mercury industry has made it possible to treat ores of successively lower grades. In 1875 the principal domestic producer was the New Almaden mine in California, and the grade of ore produced there averaged 3.35 percent or 67 pounds of mercury per ton. By 1910 the average yield of all ores treated in the United States had declined to 0.63 percent (12.6 pounds), and in recent years it has approximated 0.40 percent (8 pounds). Not all of this decline in grade, however, can be ascribed to technologic improvement, because it is also due in part to the rise of prices resulting from the tariff, first imposed in 1883 and substantially increased in 1922, which has made possible the mining and treatment of lower-grade ores.

Since the World War, production has been derived from an increasing number of small mines. Some of the new developments in mine mechanization have not been applicable to mercury mines because these were too small to warrant the capital investments required. Mercury does not occur typically in extensive low-grade disseminated deposits, so that there is little possibility of applying the large-scale mass production methods used, for example, in copper mining.

Improvement in metallurgical practice has increased recovery and reduced costs in treating mercury ores. The introduction of the Scott furnace in 1875 at New Almaden, Calif., is perhaps the most significant improvement in an art that has been practiced for centuries. This invention permitted continuous treatment of ores and the use of fine sizes which hitherto had been difficult to handle. Subsequently, the need for still lower costs and greater tonnages led to the introduction in 1916 of mechanical furnaces of the multiple-hearth and rotary-kiln types, which now are widely used in the domestic industry. Retorts, which were used extensively prior to 1875, are now employed only for the treatment of special byproducts at furnace plants or at small mines where the high first cost of the more efficient smelting units is not justified. Concentrating methods for treating low-grade ores have not been developed to any great extent, and many authorities believe that improvement in this direction will be limited.

Summarizing, the technique of treating mercury ores has advanced considerably in recent years. Doubtless, additional improvement will be made, but it is believed that the art is approaching maturity and that if technology is to maintain production at the present level it will have to do so through improvements in methods of finding new ore bodies.

*National requirements.*—The principal military uses for mercury are in the manufacture of fulminate for detonating high explosives, drugs (calomel, corrosive sublimate, etc.), dental amalgam, and antifouling paint for ship bottoms. The apparent consumption of mercury was nearly 24,000 flasks annually in the 5-year period 1912–16. In the war years, 1917–18, consumption averaged 33,000 flasks, or 38 percent higher. The apparent annual consumption for the 10 years ending 1937 amounted to 28,000 flasks. From 1926 to 1929, however, and in 1936 and 1937, consumption exceeded 30,000 flasks. Thus future domestic requirements under normal conditions may be estimated at 35,000 flasks per annum. Assuming an increase of about one-third during a war emergency, the requirements would probably approximate 46,000 flasks annually.

On April 3, 1939, the Senate passed a bill which provides $10,000,000 a year for 3 years, 1940 to 1943, for the purchase of strategic and critical materials for stockpile purposes. A similar bill, which, how-

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ever, provides a total of $100,000,000 in 4 years, has been reported to the House by the House Military Affairs Committee.

## HEALTH HAZARDS

Mercury poisoning has been discussed at length by Neal.[3] Neal listed industries with potential mercury hazards as including the mining of cinnabar, gold, and silver; chemical manufactures of mercury compounds, also of cyanogen and electrolytic chlorine; manufacture of alloy and amalgam; electrical industries of several types; the felt industry; dentistry; chemical and physical laboratories; the manufacture of pharmaceuticals and explosives; decoration of china and porcelain; photography; certain phases of the printing industry; paints; engraving; jewelry; mercury boilers; dry-battery manufacture; gilding; bronzing; and the hardening of steel tools by quenching in mercury. He says mercury poisoning may develop from introduction of mercury through four routes: (1) Inhalation of vapor or dust, (2) ingestion, (3) the skin, and (4) subcutaneous tissues. The first route is the common one in industrial mercury poisoning. The symptoms of the two types of chronic mercury poisoning, threshold dosages, diagnoses, and prevention are discussed.

Prevention of mercury poisoning is described in General Electric Co. Handbook GEQ–104, which gives results of the company's experiences and quotes from Bureau of Mines Bulletin 222[4] and other sources. The General Electric Co. has developed a mercury vapor detector through which vapors invisible to the human eye cast an ultraviolet shadow. An extremely low ratio of mercury to air (as little as 1 part mercury to 1 billion parts of air) casts the shadow distinctly.

## STOCKS

Reliable information indicates that there were no stocks at Spanish ports at the end of 1937 and that little metal was on hand at the Almaden mine. Roura & Forgas were reported to have had 22,000 flasks of mercury in stock in London at the end of 1937. Italian inventories were believed to have been low at that time. Additions were made to Italian stocks in 1938 by the large excess of production over exports, but further data are lacking concerning the other centers. Producers' stocks in the United States were not much in excess of 1,000 flasks at the end of 1938, and stocks in domestic warehouses totaled 553 flasks.

## PRICES

The average quoted price for quicksilver at New York in 1938 was 16 percent below that in 1937. Demand was low as the year began, and the average monthly price declined from $79.24 in January to $71.02 in April, the lowest monthly price for the year. Large purchases by a San Francisco bank in April and May, purported in the trade to range from 2,000 to 2,500 flasks, were partly responsible for the rapid advance to $80.73 in June, the highest level of the year. The price declined after June to $73.48 in October then advanced to $76.77 in December, and the upward movement of prices continued

[3] Neal, Paul A., Mercury Poisoning from the Public Health Viewpoint: Am. Jour. Public Health, vol. 28, No. 8, August 1938, pp. 907–915.

[4] Duschak, L. H., and Schuette, C. N., The Metallurgy of Quicksilver: Bureau of Mines Bull. 222, 1925, 173 pp.

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in 1939. Demand abroad was better than in this country, consequently the New York and London price differential was lower in 1938 than at any time since 1931, when the United States had an excess of production and exported relatively large quantities of metal. The London price fell only 4 percent compared with a 16-percent decline in New York, thus the differential between New York and London prices was only $8.55 in 1938 compared with $20.53 in 1937. The domestic tariff is $19 a flask.

*Average monthly prices per flask (76 pounds) of mercury at New York and London and excess of New York price over London price, 1936–38*

| Month | 1936 | | | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|---|---|---|
| | New York [1] | London [2] | Excess of New York over London | New York [1] | London [2] | Excess of New York over London | New York [1] | London [2] | Excess of New York over London |
| January | $76.77 | $64.02 | $12.75 | $90.25 | $69.52 | $20.73 | $79.24 | $64.31 | $14.93 |
| February | 77.00 | 63.01 | 13.99 | 91.00 | 69.98 | 21.02 | 76.46 | 64.54 | 11.92 |
| March | 77.00 | 64.10 | 12.90 | 91.78 | 70.43 | 21.35 | 72.44 | 63.61 | 8.83 |
| April | 76.73 | 62.40 | 14.33 | 92.00 | 70.61 | 21.39 | 71.02 | 63.07 | 7.95 |
| May | 74.94 | 61.81 | 13.13 | 95.52 | 75.89 | 19.63 | 74.64 | 65.63 | 9.01 |
| June | 74.19 | 62.05 | 12.14 | 96.65 | 75.29 | 21.36 | 80.73 | 68.98 | 11.75 |
| July | 73.42 | 60.96 | 12.46 | 93.90 | 73.41 | 20.49 | 76.86 | 68.58 | 8.28 |
| August | 73.92 | 61.57 | 12.35 | 91.42 | 67.70 | 23.72 | 75.50 | 67.90 | 7.60 |
| September | 85.28 | 64.97 | 20.31 | 89.02 | 67.30 | 21.72 | 74.42 | 66.83 | 7.59 |
| October | 89.24 | 67.23 | 22.01 | 86.14 | 65.61 | 20.53 | 73.48 | 68.90 | 4.58 |
| November | 90.25 | 69.65 | 20.60 | 83.44 | 65.01 | 18.43 | 74.07 | 68.81 | 5.26 |
| December | 90.25 | 69.94 | 20.31 | 81.04 | 65.02 | 16.02 | 76.77 | 70.99 | 5.78 |
| Average | 79.92 | 64.33 | 15.59 | 90.18 | 69.65 | 20.53 | 75.47 | 66.92 | 8.55 |

[1] Engineering and Mining Journal, New York.
[2] Mining Journal (London) prices in terms of pounds sterling converted to American money by using average rates of exchange recorded by the Federal Reserve Board.

## CONSUMPTION AND USES

Figures covering the available supply of mercury in 1938 indicate that consumption declined sharply from 1937. Although the rate of consumption was lower in 1938, the use of metal obtained from foreign ores, which are not covered by import statistics or domestic production figures, and possible withdrawals from consumers' stocks resulted in actual consumption being considerably above apparent consumption.

The General Electric Co. reports that a new mercury boiler, which will require 100,000 pounds of metal, will be installed in 1939. It estimates that an additional 4,000 to 5,000 pounds of mercury will be required in 1939, principally for mercury lamps and mercury switches.

Lignasan is a product made by du Pont for use in controlling sap stain in the timber industry, in which the active ingredient is 6.25 percent ethyl mercury chloride, equivalent to slightly less than 5 percent metallic mercury. A new Lignasan, claimed to be superior to the older type, contains 6.25 percent ethyl mercury phosphate.

During 1938 the completion of fluorescent lamps with 3 to 10 times the efficiency of Mazda lamps was announced. In these units an arc is maintained between electrodes in the ends of evacuated glass tubes. Mercury vapor sustains the arc.

A new wall-type mercury switch may consume a fair quantity of metal.

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A submersible turbine pump has been developed in which the water is sealed out at the top by mercury in a rotating cup attached to the motor shaft.

Two new fungicides were announced early in 1939 by Mer-Q-Ree, Inc.—Mer-Q-Ree for use in exterior paints and R888 (mercury fill) for use in interior paints. Both are furnished in semiliquid form and are described as easily miscible.

An artificial minnow that contains a small quantity of mercury to make it wiggle in a lifelike manner as it is trolled through the water is being manufactured by the Mercury Bait Co. of Cleveland.

## REVIEW BY STATES

Output of mercury in the United States in 1938 increased 9 percent over the relatively stationery production in 1937 and 1936. The gain in 1938 was due mainly to larger production by the New Idria, Mount Diablo, Mirabel, Oat Hill, and Great Western mines in California and by the Bonanza mine in Oregon, which more than offset the closing of the Oceanic mine in midyear, the idleness of the Big Bend mine, and reduced activity at other Texas properties, as well as lower production at some of the properties that remained active most or all of 1938. California's output rose from 9,743 flasks in 1937 to 12,277 in 1938, and its share of the total jumped from 59 percent to 68 percent. Oregon, the second largest producing State, increased its output from 4,264 to 4,610 flasks, while its share of the country's total was 26 percent, as in 1937. Production in Nevada remained unimportant, but activity in the Bottle Creek district was claimed to point the way toward greater production in the future. Alaska also produced some metal in 1938 and anticipated expansion. Output in Texas declined in 1938. Arkansas failed to increase production in 1938, and Washington's output remained insignificant. The principal producing mines in 1938 were as follows: California: Contra Costa County, Mount Diablo mine; Lake County, Great Western, Mirabel, and Sulphur Bank mines; Napa County, Oat Hill mine; San Benito County, New Idria mine; San Luis Obispo County, Klau and Oceanic mines; and Sonoma County, Cloverdale mine. Oregon: Douglas County, Bonanza mine; Jefferson County, Horse Heaven mine; Lane County, Black Butte mine; and Malheur County, Opalite mine. Texas: Brewster County, Chicos and Rainbow mines. These 15 mines produced 90 percent of the country's total compared with 86 percent by the 15 principal mines in 1937.

*Mercury produced in the United States, 1937–38*

| Year and State | Producing mines | Flasks of 76 pounds | Value [1] | Year and State | Producing mines | Flasks of 76 pounds | Value [1] |
|---|---|---|---|---|---|---|---|
| 1937 | | | | 1938 | | | |
| Arizona | 3 | 37 | $3,337 | California | 52 | 12,277 | $926,545 |
| California | 54 | 9,743 | 878,624 | Nevada | 17 | 336 | 25,358 |
| Nevada | 20 | 198 | 17,855 | Oregon | 13 | 4,610 | 347,917 |
| Oregon | 14 | 4,264 | 384,527 | Alaska, Arkansas, Texas, and Washington | 9 | 768 | 57,961 |
| Arkansas, Texas, and Washington | 10 | 2,266 | 204,348 | | 91 | 17,991 | 1,357,781 |
| | 101 | 16,508 | 1,488,691 | | | | |

[1] Value calculated at average price for quicksilver at New York.

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*Alaska.*—Arthur J. Skidmore began production of mercury at the Parks Cinnabar mine in the Kuskokwim district in 1938 with an output of 8 flasks. A home-made retort is being used at this property.

*Arizona.*—No production of mercury was reported for Arizona in 1938. At the Ord group work was confined to remodeling the rotary furnace and development underground.

*Arkansas.*—S. E. Evans produced mercury at the Caddo mine in Clark County in 1938. This property and the mine of the Southwestern Quicksilver Co., in Pike County, were the principal producers in Arkansas. The mine of the Mid-Continent Quicksilver Co., also in Pike County, was operated under bankruptcy in 1938, part of the time by a lessee and part of the time by a trustee. Increased activity is expected at this mine in 1939. It is reported that the Big Six Mining Co. plans to build a rotary furnace at its mine in 1939.

Mercury deposits in southwestern Arkansas have been described by Reed and Wells.[5]

*California.*—As usual, California was the principal mercury-producing State in 1938. The production of 12,277 flasks in 1938 was 26 percent larger than in 1937, despite the midyear closing of the Oceanic mine, one of the largest producers in California. The increase was due largely to greater production at the New Idria mine. Contra Costa, Fresno, Inyo, Kern, Kings, Lake, Monterey, Napa, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Solano, Sonoma, Trinity, and Yolo Counties contributed to California's output. The New Idria mine in San Benito County, operated by the New Idria Quicksilver Mining Co., was the largest producer. Other large producers were the Mount Diablo mine in Contra Costa County; Sulphur Bank, Mirabel, and Great Western mines in Lake County; Oat Hill mine in Napa County; Klau and Oceanic mines in San Luis Obispo County; New Almaden mine and dumps in Santa Clara County; and Cloverdale mine in Sonoma County.

The Bradley Mining Co. operated its Mount Diablo mine in Contra Costa County throughout the year and made an important production of quicksilver.

The Archer and Mercy mines in Fresno County were operated in 1938. Production at both properties was made in retorts. It was reported that O. R. Rodgers plans to install a concentrating plant at the Mercy mine.

Mercury was produced at the Coso mine, Inyo County, in 1938 by A. W. Legge. A 20-ton Nichols-Herreshoff furnace was installed at this property during the year.

The Walabu Mining Co. produced 31 flasks of mercury at the Cudde, back mine, Kern County, in a Gould rotary furnace.

Bert Harvey produced metal at the Kings mine, Kings County, in 1938.

The principal producers in Lake County were the Sulphur Bank and Great Western mines of the Bradley Mining Co. and the Mirabel mine of the Mirabel Quicksilver Co. Three other properties were producing in 1938. Lake County produced 3,715 flasks of mercury in 1938, the second most important output in California.

[5] Reed, J. C., and Wells, F. G., Geology and Ore Deposits of the Southwestern Arkansas Quicksilver District. Geol. Survey Bull. 886-C, 1938, pp. 15-90.



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Operations were continued for 6 months of the year and mercury was produced at the Franciscan mine, Monterey County, formerly known as the Patriquin mine.

Six properties in Napa County produced mercury in 1938. The principal mine was the Oat Hill, which was active from January 1 to September 1 and recovered 487 flasks of metal in a Gould rotary furnace. The mine was reopened in January 1939. Other producers were the Aetna, Manhattan, Oat Hill Extension, La Joya, and James Creek mines.

The principal mercury-producing mine in the United States, as well as in California, was the New Idria, San Benito County. Two of the four Gould rotary furnaces at the property were operated during the year, treating newly mined ore and material from the old Scott furnace and coarse-ore furnace dumps. About 200,000 tons of dump material averaging about 3½ pounds of mercury to the ton are still available at the mine. Trade reports indicated that 125 men were employed at the property in the final quarter of the year. A labor strike at the mine which lasted 2 months was settled in January 1939. Eight other properties, chief among which was the Aurora, produced mercury in San Benito County in 1938.

San Luis Obispo County produced 1,111 flasks of mercury in 1938. The principal producers were the Oceanic and Klau mines. At the Oceanic mine 11,334 tons of ore were treated in a 75-ton rotary furnace and 597 flasks of metal produced. This mine was closed in midyear, and negotiations for its sale apparently did not result in a change in ownership. The Klau mine was reported to be operating with a skeleton crew at the end of 1938. There were five other producers in the county in 1938.

The Red Rock mine of the Santa Ynez Mercury Corporation, Ltd., in Santa Barbara County, a large producer of mercury in 1937, also produced in 1938, but the company went into receivership in the first half of the year, and the mine was idle thereafter. P. B. de Mandel reported that the Cal-Mer (Lion's Den) mine was closed because reserves of ore were exhausted.

Mercury was produced from newly mined ore and from surface dumps at the New Almaden and Guadalupe mines in Santa Clara County. Metal was also produced at the North Almaden mine.

A new screening concentrating plant with a capacity of 420 to 450 tons a day was completed and put into operation at the Cloverdale mine, Sonoma County, in 1938. Geo. H. Burr, Jr., president and general manager of the producing company, estimated in October that 250,000 tons of 1-percent ore were in sight. After a substantial production the mine was closed late in the year owing to financial difficulties. Trade reports indicated that a new Wyatt furnace was completed and placed in service at the Contact mine in 1938. Five other properties produced mercury in Sonoma County.

*Idaho.*—Press reports indicate that a large deposit of cinnabar ore was discovered recently 16 miles from Weiser and was leased for a 20-year period to L. K. Requa.

*Montana.*—A cinnabar vein is reported in the press to have been discovered by the Western Mines Corporation at its property in Fergus County.

*Nevada.*—Mercury was produced in Esmeralda, Humboldt, Mineral, Nye, and Pershing Counties in 1938, but the total output of the State

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was only 336 flasks. Considerable prospecting and development work were reported around Fallon and in the Bottle Creek district, Humboldt County. Several properties in Humboldt County produced metal, and press reports claimed that increased production could be expected from this area. Retorts were constructed at two or more mines in Humboldt County during the year, and other retorts were reported to be under construction. Frequent rumors that the Castle Peak mine was about to be optioned to one or another company and reopened failed to result in any production at this Storey County mine. Early in 1939, however, it was reported that the American Quicksilver Corporation had optioned the property and soon would start active operations.

*Oregon.*—Production of quicksilver in Oregon totaled 4,610 flasks in 1938, an increase of 8 percent over 1937. The increase was due mainly to greater activity at the Bonanza mine, Douglas County, where H. C. Wilmot is manager. The recovery of 1,183 flasks of metal from 14,914 tons of ore placed this mine among the leading mercury-producing properties in the country. The other principal producers in Oregon in 1938 were the Horse Heaven mine, Jefferson County, and the Black Butte mine, Lane County. Production was also made in Clackamas, Crook, and Malheur Counties.

Five producing properties in Crook County failed to make a large contribution to the country's total.

The Horse Heaven mine, Jefferson County, was the largest mercury producer in Oregon in 1938 and the second largest in the country. Two other properties in this county produced the metal.

The Quicksilver Syndicate, operating the Black Butte mine, Lane County, treated 19,701 tons of ore in two 75-ton rotary furnaces and recovered 803 flasks of mercury in 1938.

The Opalite mine of the Bradley Mining Co., Malheur County, leased for part of the year, produced in 1938. The furnace building at the mine was destroyed by fire in December 1938.

## FOREIGN TRADE [6]

Imports of mercury for consumption in the United States in 1938 were only 12 percent of the relatively constant rates for 1936 and 1937. Of the 1937 total, more than one-half arrived in the first 4 months. Importations virtually ceased in the closing months of 1937, and this lack of activity was characteristic of most of 1938. Of the 2,362 flasks received, 1,111 flasks were credited to Italy and 1,251 flasks to Spain. Metal known to have been exported from Mexico to this country must have been reexported abroad, because none is credited to Mexico in import statistics. Antimony-mercury concentrates imported from Mexico are treated in this country, and the metal produced therefrom, aggregating more than 2,600 flasks in 1938, is consumed here. Statistics covering this movement are not shown separately in foreign-trade records.

[6] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Mercury imported into the United States, 1934–38, by countries*

| Country | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value |
| Hong Kong | | | | | | | 5 | $5 | | |
| Italy | 49,285 | $33,339 | 68,705 | $30,735 | 491,714 | $385,236 | 747,266 | 649,406 | 84,454 | $50,434 |
| Mexico | 188,494 | 120,914 | 4,182 | 2,975 | 26,393 | 21,708 | 116,497 | 104,730 | | |
| Spain | 536,025 | 326,635 | 521,017 | 347,806 | 774,785 | 544.072 | 535,156 | 440,804 | 95,068 | 82,176 |
| Sweden | 760 | 600 | | | | | | | | |
| United Kingdom | | | | | 81,760 | 66,801 | 38,788 | 33,046 | | |
| | 774,564 | 481,488 | 593,904 | 381,516 | 1,374,652 | 1,017,817 | 1,437,712 | 1,227,991 | 179,522 | 132,610 |

The threatened invasion by foreign producers of the domestic market for mercury compounds appears to have been unfounded, as importations under this class decreased.

*Mercury compounds imported for consumption in the United States, 1937–38*

| Compound | 1937 | | 1938 | |
|---|---|---|---|---|
| | Pounds | Value | Pounds | Value |
| Chloride (mercuric) (corrosive sublimate) | 35,524 | $16,781 | | |
| Chloride (mercurous) (calomel) | 22,618 | 14,852 | 265 | $358 |
| Mercury preparations (not specifically provided for) | 15,737 | 9,252 | 11,786 | 7,604 |
| Oxide (red precipitate) | 4,405 | 2,740 | 1,011 | 815 |
| Vermilion reds (containing quicksilver) | 52,708 | 49,137 | 33,884 | 30,243 |
| | | 92,762 | | 39,020 |

Exports of mercury totaled 713 flasks valued at $50,184 in 1938 compared with 454 flasks valued at $37,165 in 1937. Of the 1938 total, 160 flasks went to South America, 405 flasks to the United Kingdom, and the remainder in small lots to nearly two dozen countries.

## WORLD PRODUCTION

The following table shows world production of mercury, by countries, from 1934 to 1938.

*World production of mercury, 1934–38, by countries*

[Compiled by R. B. Miller]

[1 metric ton = 29.008 flasks of 76 pounds]

| Country | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Flasks | Metric tons | Flasks | Metric tons | Flasks | Metric tons | Flasks | Metric tons | Flasks | Metric tons |
| Algeria | | | | | 102 | 3.5 | 114 | 3.9 | 130 | 4.5 |
| Australia: Queensland | 3 | 0.1 | 17 | 0.6 | 78 | 2.7 | 9 | .3 | (1) | (1) |
| Austria | | | 12 | .4 | 3 | .1 | 134 | 4.6 | (1) | (1) |
| Bolivia [2] | 557 | 19.2 | 250 | 8.6 | 224 | 7.7 | 16 | .6 | | |
| Canada | | | | | | | | | 10 | .3 |
| China [2] | 2,950 | 101.7 | 1,313 | 45.3 | 2,460 | 84.8 | 1,736 | 59.8 | 65 | 2.2 |
| Chosen | | | 4 | .1 | 2 | .1 | 2 | .1 | (1) | (1) |
| Czechoslovakia | 763 | 26.3 | 2,004 | 69.1 | 1,876 | 64.7 | 275 | 94.8 | (1) | (1) |
| Germany | | | 116 | 4.0 | 1,093 | 37.7 | [3] 1,741 | [3] 60.0 | (1) | (1) |
| Italy | 12,804 | 441.4 | 28,191 | 971.8 | 42.732 | 1,473.1 | 66,963 | 2,308.4 | 66,719 | 2,300.0 |
| Japan | 196 | 6.8 | 148 | 5.1 | 429 | 14.8 | 580 | 20.0 | (1) | (1) |
| Mexico | 4,580 | 157.9 | 6,277 | 216.4 | 5,307 | 183.0 | 4,936 | 170.2 | 8,519 | 293.7 |
| New Zealand | 49 | 1.7 | 7 | .3 | | | 18 | .6 | (1) | (1) |
| Rumania | 2 | .1 | 1 | .1 | 2 | .1 | (1) | (1) | (1) | (1) |
| Spain | 31,799 | 1,096.2 | 35,559 | 1,225.8 | 43,424 | [3] 1,497.0 | 28,357 | [3] 977.5 | 40,000 | [3] 1,378.9 |
| Tunisia | | | 25 | .8 | 72 | 2.5 | 25 | .9 | 201 | 6.9 |
| Turkey | 41 | 1.4 | 25 | .9 | 836 | 28.8 | 484 | 16.9 | (1) | (1) |
| U. S. S. R. | 7,750 | [4] 267.6 | 8,700 | [4] 300.0 | 8,700 | [4] 300.0 | 8,700 | [4] 300.0 | (1) | (1) |
| United States | 15,445 | 532.4 | 17,518 | 603.9 | 16,569 | 571.2 | 16,508 | 569.1 | 17,991 | 620.2 |
| | 76,939 | 2,652.8 | 100,167 | 3,453.2 | 123,109 | 4,271.8 | (1) | (1) | (1) | (1) |

[1] Data not yet available.
[2] Exports.
[3] Estimated.
[4] Imperial Institute, Loudon and Metallgesellschaft.

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*Algeria.*—The Societe Nouvelle des Mines de Ras-el-ma has been registered with a capital of 510,000 francs to work the Ras-el-ma quicksilver deposits, the only quicksilver deposits of note in Algeria.

*Canada.*—Nelson P. Meeks, American Vice Consul, reported in midyear of 1938 that although no mercury had been produced on a commercial scale in British Columbia a group of Montreal and Vancouver men were developing a property on Mud Creek in Bridge River Valley. He said that recent press reports indicated that additional deposits of this mineral had been found 15 miles north of the operations on Mud Creek, following erosions and slides that bared the surface of a slab of rock 50 feet wide and many feet deep. The new discovery has lower average values than that at Mud Creek, but tonnage possibilities were believed to exist.

A 10-ton testing furnace began recovery of the metal in the late months of the year.

*Czechoslovakia.*—An article in the Mining World & Engineering Record of February 25, 1939, stated that a French company recently produced about 143,300 pounds of quicksilver in the mines at Mernik and Teplou.

*Italy.*—Italy continued to be the principal world source of mercury in 1938, and output was maintained at virtually the record level of 1937. Production totaled 66,719 flasks in 1938 compared with 66,963 flasks in 1937 and an average of 39,800 flasks for the 10-year period, 1927–36. Demand for Italian metal fell in 1938, however, and exports were only 55,327 flasks compared with 67,075 flasks in 1937. Despite this drop, exports in 1938 were considerably above the 41,357 flasks and 35,851 flasks shipped in 1936 and 1935, respectively, before the civil war in Spain interfered with the normal flow of metal from that source. Stocks of metal in Italy were reported to be low at the end of 1937, but they were substantially increased in 1938 by the excess of production over exports.

*Mercury produced in Italy in 1936, by Provinces*

| Province | Ore mined | | | | | | Metal produced | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of mines | Number of workmen | Metric tons | Tenor (percent) | Value [1] | Tons per man | Number of plants | Number of workmen | Flasks (76 pounds) | Value [1] | Flasks per man |
| Cagliari (Iglesias) [2] | ------ | ------ | ------ | ------ | ------ | ------ | (3) | (3) | 30 | $1,907 | (3) |
| Gorizia (Trieste) | 1 | 541 | 43,510 | .785 | $399,426 | 80 | 1 | 83 | 8,936 | 578,840 | 108 |
| Grosseto (Firenze) | 1 | 189 | 7,270 | .50 | 37,259 | 38 | 2 | 21 | 1,057 | 69,064 | 50 |
| Siena (Firenze) | 3 | 626 | 90,534 | 1.25 | 1,768,086 | 145 | 3 | 263 | 32,709 | 2,137,665 | 124 |
| | 5 | 1,356 | 141,314 | .845 | 2,204,771 | 104 | 6 | 367 | 42,732 | 2,787,476 | [3] 116 |

[1] Lire converted to dollars at the average annual rate of exchange, as published by the U. S. Federal Reserve Board.
[2] Product recovered in the plant of the Società di Monteponi from condensation of mercury vapor obtained in lead smelting.
[3] Exclusive of output at Cagliari.

The most productive deposits in Italy are those of the Month Amiata district in Tuscany, Province of Siena; next in importance are the Government-owned Idria mines, in the foothills of the Julian Alps, Province of Gorizia. According to the Metal Bulletin of November 15, 1938, other producers are the properties of the S. A. Mineraria Argus at Abetina in Tuscany, Province of Siena, and Stabilimento

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Minerario del Siele, also in Tuscany. The Amalgamated Merchants, Ltd., of London, represents "Mercurio Italiano" and has accounted for about 88 percent of Italian mercury sales. The Argus mine is the principal producer not included in Mercurio Italiano, and the 3,000 to 5,000 flasks ordinarily recovered at this property are sold in the open market.

Of the mercury exported by Italy in 1938, 59 percent went to Germany, 12 percent to Japan, and 6 percent to France. Exports to Germany increased from 24,000 flasks in 1937 to 32,600 in 1938 and those to Japan from 4,000 to 6,600 flasks.

According to Sheridan Talbott, American consul, Leghorn, Italy, workers at the Monte Amiata mine received the following hourly wages in 1938.

*Hourly wage rates at the Monte Amiata mine in 1938, by classes of workers*

| | *Lire* |
|---|---|
| Inside workers: | |
| Miners | 2.354 |
| Assistant miners | 2.259 |
| Laborers, unskilled | 2.165 |
| Outside workers: | |
| Firemen | 1.97 |
| Laborers, unskilled | 1.73 |
| Mechanics, locksmiths, carpenters | 2.14 |

The workday for inside laborers is 7 hours, while that for the remainder is 8 hours. Rates for piecework are 33 percent higher for miners, 31 percent for assistant miners, 35 percent for unskilled laborers working inside the mines, and 30 percent for all others. Overtime rates are 15 percent above normal rates for all categories. The workers are paid for 4 holidays and for a 6-day vacation. Family allowances range from 3.60 lire a week for one child to 6 lire each for four or more children. The family allowances are paid until each child is 14 years old. There is a wage tax of 4 percent on net wages exceeding 180 lire a week, a social-insurance contribution of 2.05 lire a week, and some smaller deductions. The wages noted above were fixed by the collective contract of January 1, 1934, but have been increased in accordance with the decisions promulgated by the Italian Government for all classes of laborers. Furthermore, they were increased 10 percent in 1937 by the company itself. The collective contract was up for renewal in 1938, with prospects for slight wage increases. At the time the consular report was prepared, July 27, 1938, the lire was valued at $0.0526.

*Japan.*—Information covering output and imports of mercury into Japan in 1937 and 1938 is not available. That the situation regarding supplies of quicksilver is serious is attested by the strict control over commercial transactions in this metal announced during the year by the Ministry of Commerce and Industry to the prefectural governors. Reports were current early in the year that there was a brisk demand for mercury for the recovery of gold from poor ores and that mercury was also in demand for the electrolytic reduction of caustic soda.

*Mexico.*—Production of mercury in Mexico increased from 4,936 flasks in 1937 to 8,519 in 1938.

The Bureau of Mines is indebted to Vice Consul Norman L. Christianson for the following summary of operations at the Huitzuco mine.

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The Huitzuco quicksilver mine, located in north-central Guerrero, is operated at present by Explotadora de Mercurio de Huitzuco, S. A., organized in 1930 and believed to be controlled entirely by Mexican capital. A flotation mill of 160 tons of ore a day capacity is in operation. In the latter part of 1938 the mill was producing daily from 3 to 4 tons of concentrates with an average content of 7 to 11 percent mercury and 25 to 30 percent antimony. The mill was designed by Penhoel-Menardi Engineering Co., Ltd., of Los Angeles. In 1937, 515 flasks of mercury, and from January to March, 1938, 11 flasks of metal were produced experimentally in a Johnson-McKay retort. Refining of concentrates in Mexico has been discontinued, temporarily at least, and all concentrates are now being shipped to the United States for treatment. By shipping the concentrates to the United States advantages are gained in respect to both quicksilver and antimony, for imports of both of these metals are subject to duties, whereas imports of ores and concentrates of quicksilver and antimony are permitted to enter the country duty free. The concentrates are shipped by truck to Iguala, on the Mexico City-Acapulco highway, about 124 miles from the capital and 15 miles from the mine. From Iguala they are sent by rail to Mexico City and thence by rail to Los Angeles, via El Paso, Texas. In 1937, 30,184 short tons of ore, with an average content of 0.315 percent mercury and 1.25 percent antimony, were produced and from January 1 to November 30, 1938, 46,822 tons, containing 0.24 percent mercury and 0.96 percent antimony were produced. Concentrates totaling 552 tons, shipped to the United States in 1937, contained the equivalent of 1,205 flasks of mercury, and those shipped from January 1 to December 19, 1938, contained the equivalent of 2,605 flasks of metal. The reduction of the concentrates has been described by Menardi.[7] Exports of mercury from Mexico for the first 10 months of 1938 totaled 6,908 flasks compared with 4,610 flasks in all of 1937.

*Spain.*—Official statistics covering production and exports of mercury from Spain are not available. However, Roura & Forgas, selling agents for Almaden metal, report that exports totaled 43,424 flasks in 1936, 28,357 in 1937, and 31,060 for 10 months of 1938. Their estimate for all of 1938 was 40,000 flasks. Production during the 3-year period, 1936–38, was below exports, and large quantities of metal were shipped from stocks. There were no stocks of mercury at Spanish ports at the end of 1937 and only small stocks at the Almaden mine.

The Almaden quicksilver industry is discussed at length in Deutsche Bergwerks Zeitung of March 29, 1939, and an abstract of the article appears in the Mining Journal of London.[8]

Information on annual wage rates paid at the Almaden mine in 1938 were reported by American Vice Consul Woodruff Wallner, Valencia, Spain, to be as follows:

[7] Menardi, H. B., Reduction of Livingstonite Concentrate: Am. Inst. Min. and Met. Eng., Metals Technol., vol. 6, No. 2, February 1939, 8 pp.
[8] Mining Journal, London, The Almaden Quicksilver Industry: Apr. 8, 1939, p. 377.

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*Annual wage rates at the Almaden mine in 1938, by classes of workers*

| Class of worker | Pesetas | Equivalent at 20 to $1 | Class of worker | Pesetas | Equivalent at 20 to $1 |
|---|---|---|---|---|---|
| Inside workers: | | | Outside workers—Continued. | | |
| Quarry drillers, master masons, first-class firemen, and shorers | 4,512.00 | $225.60 | Workshop helpers, warehousemen, shipping-department helpers, messengers, gardeners, guards at Almadenejos, and hospital doorkeeper | 3,120.00 | $156.00 |
| Watchmen and second-class shaft diggers | 4,800.00 | 240.00 | Laborers in tool deposits, track workmen, pit guards, and lime-pit brigade | 3,360.00 | 168.00 |
| Track foremen, dumpcart men and shale laborers, masons' helpers, second-class shorers, chute men, mechanics, and second-class firemen | 4,032.00 | 201.60 | Inspector in charge of outside work and inspector in charge of works and repairs | 4,800.00 | 240.00 |
| Various shale laborers, shaft carpenters, and mechanics' helpers | 3,600.00 | 180.00 | Inspectors | 3,660.00 | 183.00 |
| Mine watchmen | 5,400.00 | 270.00 | Women for cleaning | 2,160.00 | 108.00 |
| First-class miners | 4,980.00 | 240.00 | Woman in charge of rest house, dispensary and school garden porters | 2,555.00 | 127.75 |
| Outside workers: | | | Hospital nurses (male) | 2,340.00 | 117.00 |
| Engine drivers at San Teodora and San Aquilino, first-class power station electricians, first-class machine-shop and quarry foremen | 4,512.00 | 225.60 | Nurses (female), cooks, washerwoman, and hospital janitress | 1,800.00 | 90.00 |
| Drivers of compressors and locomotives, power-station helpers, drivers of mechanical vehicles, and second-class machine-shop men | 4,302.00 | 201.60 | "Buitrones" works: | | |
| Ventilator mechanics | 3,912.50 | 195.62 | Spirek and works foremen | 4,800.00 | 240.00 |
| Smelting mechanics, lime-pit foremen, pit foremen, and timekeepers | 3,780.00 | 189.00 | First-class lime workers and Spirek conveyor-belt foreman | 4,512.00 | 225.60 |
| Oilers, workshop apprentices, errand boys, and messengers | 2,400.00 | 120.00 | Second-class lime workers | 4,032.00 | 201.60 |
| Heating installation and workshop foremen | 4,932.00 | 246.60 | Quicksilver weighers | 4,632.00 | 231.60 |
| Third-class workshop men and scale men | 3,600.00 | 180.00 | Workmen on the quicksilver tubes | 3,900.00 | 195.00 |
| | | | Quicksilver box cleaners | 3,780.00 | 189.00 |
| | | | Master masons | 4,272.00 | 213.60 |
| | | | Master masons' assistants | 3,960.00 | 198.00 |
| | | | Master masons' laborers | 3,600.00 | 180.00 |
| | | | Pit laborers | 3,360.00 | 168.00 |

*United Kingdom.*—Mercury was shipped directly to foreign countries from Spain in 1936, but since the beginning of 1937 all available metal has been exported to London for distribution. As a consequence, figures for imports and reexports of quicksilver for the United Kingdom jumped sharply in 1937 and 1938. Imports were 44,317 flasks in 1938, 49,894 in 1937, and 22,468 in 1936, and reexports during those years were 15,535, 28,127, and 5,571 flasks, respectively. From these data it is evident that the United Kingdom, one of the largest mercury-consuming countries in the world, consumed more metal in 1938 than in 1937. Roura & Forgas, selling agents for the Almaden mine in Spain and Amalgamated Merchants, Ltd., selling agents for most of the Italian metal, have combined offices in London. At the end of 1937 Roura & Forgas were reported to have 22,000 flasks of metal on hand in London. As inventories in Italy and at Spanish ports were low or nonexistent, this metal represented the principal stocks of quicksilver for sale at that time.

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# TIN [1]

By E. W. Pehrson and John B. Umhau

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The prosperous conditions prevailing in the world tin industry during 1937 were sharply reversed in 1938. A substantial decline in demand for tin products in the United States resulting from the industrial recession caused an abrupt curtailment in the consumption of pig tin. This situation was aggravated by the liquidation of stocks of semimanufactured goods (acquired in 1937 in anticipation of price increases), particularly tin plate, production of which declined 40 percent from the all-time high established in 1937, although the demand for tin cans declined only 10 percent, judged from the trend in food packing. Domestic use of tin in solder, babbitt, bronze, and collapsible tubes and foil showed major declines, reflecting the narrower market for automobiles and other consumer goods. Consequently, imports of pig tin, were 44 percent below the record established in 1937. New York prices moved downward during the first part of the year and early in May reached the lowest level since May 1933. Visible stocks of tin in the United States decreased during 1938, and consumers' stocks increased little, if at all; total stocks dropped about 15 percent.

*Salient statistics for tin in the United States, 1925–29 (average) and 1934–38*

| | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Production— | | | | | | |
| From domestic mines, long tons | 24 | 8.2 | 44.5 | 101.0 | 168.4 | [1] 109 |
| From secondary sources, do | 30,600 | 22,200 | 24,900 | 25,000 | 27,100 | 21,080 |
| Imports for consumption (metal), do | 78,009 | 39,986 | 64,258 | 76,029 | 88,115 | 49,699 |
| Exports (domestic and foreign)[2], do | 1,740 | [1] 1,216 | [2] 2,292 | [1] 386 | [1] 313 | [1] 205 |
| Monthly price of Straits tin at New York: | | | | | | |
| Highest, cents per pound | 70.67 | 55.60 | 52.29 | 51.85 | 62.71 | 46.23 |
| Lowest, do | 39.79 | 50.87 | 46.91 | 42.22 | 42.85 | 36.84 |
| Average, do | 56.64 | 52.16 | 50.39 | 46.42 | 54.24 | 42.26 |
| World production, long tons | 163,000 | 120,400 | 135,300 | 179,300 | 210,200 | 147,500 |
| Ratio United States imports to world production, percent | 48 | 33 | 47 | 42 | 42 | 34 |

[1] Subject to revision.
[2] Figures for 1934–38 cover foreign only; domestic not separately recorded.

[1] The long ton is used throughout this report.



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Outside the United States apparent consumption was approximately 10 percent less in 1938 than in 1937. In contrast to Germany, Japan, and Italy, which took more tin in 1938 than in the previous year, the United Kingdom, France, and the U. S. S. R. took less. Total world visible stocks increased 13 percent and at the end of 1938 were higher than at the end of any year since 1932.

To meet the declining demand, the International Tin Committee made successive reductions in permissible export quotas from 110 percent of standard tonnages in the last quarter of 1937 to 70 percent in the first quarter of 1938, 55 percent in the second quarter, and 35 percent in the last half of the year. World production decreased 30 percent compared with 1937. Countries signatory to the International Tin Control Scheme bore the major part of the reduction, their output having declined 33 percent whereas that of the nonsignatory countries decreased only 10 percent. The latter group produced 19 percent of the total output in 1938 and 15 percent in 1937.

The Buffer Stock Scheme proposed in 1937 was adopted officially in June 1938, and during the latter half of the year an additional production quota of 10 percent was allowed for stock accumulations. The purpose of the pool is said to be stabilization of tin prices between £200 and £230 per long ton (43.5 to 50.0 cents per pound).

*Government action affecting tin.*—The trade agreement with the United Kingdom signed November 17, 1938, bound imports of tin into the United States on the free list provided:

> That the Government of the United States of America reserves the right to withdraw the concession hereby granted if at any time after January 1, 1939, an export tax is charged in Nigeria on tin ore and concentrates exported to the United States of America other than or different from any export tax which may at the same time be charged on tin ore and concentrates exported to any part of the British Empire.

Effective January 1, 1939, the Nigerian Government reduced the export tax on tin-ore shipments to the United States in accordance with this agreement.

The tariff acts since 1922 have provided duties of 4 cents per pound on tin imported into the United States as ore and 6 cents on tin imported as metal whenever domestic production of tin amounted to 1,500 tons per annum. As there was little hope that domestic output would reach that magnitude, the chance of the tariff ever becoming effective has been extremely remote. Thus from the standpoint of the United Kingdom, this concession by the United States has little practical significance. The same may be said of the British concession on Nigerian ore. It has been stated frequently that creation of a smelting industry in the United States, based primarily on the impure tin concentrates produced in Bolivia, would be facilitated if they were mixed with the purer concentrates produced in British and Dutch possessions. Movement of these ores to the United States was precluded in the past by discriminatory export taxes. This obstacle has now been removed as regards Nigeria, and presumably anyone wishing to establish a smelting industry in the United States should be free to compete with the British smelters for clean Nigerian ores. However, in view of the existing commercial relationships between the principal Nigerian producers and the British smelting interests it is believed that despite removal of the discriminating export duty no substantial quantity of ore will be diverted to the United States.

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The appropriation bill for the Navy Department for the fiscal year 1938–39 provided $500,000 for the purchase of strategic commodities, most of which was spent for tin. Larger purchases of tin and other strategic commodities are contemplated in legislation now pending in Congress. S. 572, passed by the Senate on March 31, 1939, provides a total of $40,000,000 for this purpose over a period of 4 years and $500,000 annually for 4 years for an investigation of domestic resources of deficient minerals by the Bureau of Mines and the Geological Survey of the United States Department of the Interior. The bill was also passed by the House of Representatives on April 25, 1939, in an amended form providing $100,000,000 for stock-pile purchases. As of May 29, 1939, the conferees had agreed on the provision of $100,000,000 and the bill was awaiting final congressional approval.

H. R. 5840, passed by the House of Representatives on May 1, 1939, proposes to amend the Faddis-Barbour bill licensing the export of tin-plate scrap by including "other scrap, drosses, or residues, the tin content of which is in excess of 10 percentum in which the copper content does not exceed the tin content." Presumably this bill is designed to curtail exports of tin byproducts, such as drosses, which are reported to have increased in recent years. Official quantitative data on this trade are not available.

The McReynolds bill, H. R. 9154 of the Seventy-fifth Congress, was not introduced in the Seventy-sixth Congress. The bill was the outgrowth of the extensive tin investigation conducted by the subcommittee of the House Committee on Foreign Affairs. It provided for the creation of a Board for Strategic Materials to study the supply of tin and other strategic materials in the United States.

The Bureau of Mines conducted concentrating tests on samples of tin ore from Goodwater, Ala.;[2] Majuba Hill, Nev.;[3] and Tinton, S. Dak.[3] Report of Investigations 3404, also published by the Bureau, described the pegmatites at Tinton.[4]

## TIN AND NATIONAL DEFENSE

The present intense interest in national defense has focused attention on strategic materials in which the United States is deficient. Tin ranks high among such materials owing to the essential usefulness of the metal industrially, the lack of commercial deposits, and the almost total dependence of this country on relatively few overseas sources of supply. Under normal conditions the United States consumes more than 75,000 tons of tin annually, or approximately 45 percent of the total world output. Domestic production never has exceeded 170 tons per annum; thus requirements have been met by imported metal. During the past 5 years 81 percent of the foreign purchases was obtained from Asia (69 percent from British Malaya), 18 percent from Europe, and 1 percent elsewhere.

In time of peace this dependence on foreign sources presents no serious problem; adequate supplies usually have been available, and prices seldom have been exorbitant. In the event of war, however,

[2] Ore-Testing Section, Progress Reports—Metallurgical Division 22. Ore-Testing Studies, 1936-37: Bureau of Mines Rept. of Investigations 3370, 1938, p. 111.

[3] Metallurgical Division, Progress Reports—Metallurgical Division 27. Ore-Testing Studies, 1937-38: Bureau of Mines Rept. of Investigations 3425, 1938, pp. 86-87.

[4] Hess, Frank L., and Bryan, Barnabas, Jr., The Pegmatites at Tinton, S. Dak.: Bureau of Mines Rept. of Investigations 3404, 1938, 19 pp.

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it constitutes a serious threat to national security because foreign sources of supply are vulnerable to blockade by hostile fleets. Deprived of tin, the industrial power and hence the military effectiveness of the United States would be impaired seriously.

During the World War the procurement of deficient strategic materials, including tin, presented many grave problems, and on several occasions severe shortages were averted only by narrow margins. Despite these experiences the United States has done little toward improving its strategic position in tin and at present the problem is more acute than ever, owing to the large increase in consumption since 1918. However, the recent intense interest in national defense arising from the critical international situation has prompted exhaustive consideration of the subject of deficient raw materials by Congress, and as this is written there is every indication that constructive action soon will be taken.

Failure hitherto to adopt constructive measures to end this perilous condition has not been due to lack of proper appreciation of the problem or lack of a simple and sound method for solving it. In 1921 the War Department requested several distinguished tin experts to study the situation. Their report [5] clearly demonstrated the inadequacy of domestic deposits and the hopeless outlook for self-sufficiency in the United States. In 1934 the Planning Committee for Mineral Policy appointed by the President recommended the purchase of a stock pile of tin as the only safe way of guaranteeing adequate supplies in a war emergency. The long delay in facing the realities of the strategic mineral problem may be ascribed primarily to the fact that the American public is not military-minded; therefore there was little incentive for political leaders to stir up interest on this subject among voters whose natural apathy was increased by the prosperity of the twenties and the depression of the thirties. Moreover, a few always have claimed that the tin problem could be solved by proper encouragement of domestic production, by the establishment of a smelting industry based on imported ore, or by the use of substitutes. Obviously the development of domestic industries has a more popular appeal than the purchase of foreign products although, as will be shown, the hope of obtaining national security thereby is indeed remote.

*Domestic resources.*—In a recent (February 28, 1939) study entitled "Report upon Certain Deficient Strategic Minerals," prepared by the staffs of the Geological Survey and the Bureau of Mines, United States Department of the Interior, potential production from domestic tin deposits was summarized as follows:

> *Sources.*—Although tin minerals have been recognized widely in lode deposits in the United States, the principal source of production has been a few placer deposits, largely in a small area in Alaska. Specimens of tin minerals have been found in many places in the United States, but serious efforts to exploit tin-bearing lodes have been confined to the following districts: One in Virginia; two in South Dakota; one in Texas; one in New Mexico; one in California; one in Nevada; and one in Washington. With one exception, that near Temescal, California, each of these districts has been studied by geologists of the Geological Survey, and reports have been issued.
>
> From the nature of the lode and placer deposits of tin, and the manner by which they have been explored, it is impossible to assign definite figures to the reserves of tin. It is safe to state, however, that they are small.

[5] American Institute of Mining and Metallurgical Engineers and the Mining and Metallurgical Society of America, International Control of Minerals: New York, 1925, pp. 115–128.

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*Production from domestic mines.*—The placer tin deposits near York, Seward Peninsula, Alaska, have been known for about 40 years and have yielded a small output almost every year. The total exceeds that of all other domestic districts combined. From what is known concerning the geology of the region, and the extent of tin-bearing gravels, it is clear that the district presents the best opportunity in the United States to recover the most tin for a given expenditure, although it seems that the maximum yield cannot be more than a small part of domestic needs.

A large sum, at least five million dollars, has been expended in four districts in the United States in attempts to develop lode tin deposits. Probably the largest sum, reported to be more than three million dollars, was spent in the Harney Peak region, South Dakota, from 1884 to 1892, in exploration and mining and milling plants. The campaign yielded only 5,000 tons of crude ore containing 0.25 percent tin, in contrast to expected yields of 1.0 to 1.75 percent. Commonly, several tons of tin ore a year are produced as a byproduct in mining other minerals, but it seems very doubtful that this district contains much material that would yield more than 0.25 percent tin or 5 pounds per ton. The most encouraging area in the Black Hills is probably that near Tinton, where considerable work has been done since 1900 and 14,000 tons from one mine yielded about 0.35 percent or 7 pounds of tin per ton. Here a readily accessible reserve of several hundred thousand tons is estimated to contain from 7 to 12 pounds per ton.

The pegmatites of the Kings Mountain district, North and South Carolina, resemble those of the Black Hills and more than $500,000 has been spent since 1887 in attempts to recover tin from several deposits. The largest shipments from a single deposit (Ross Mine) amount to about 130 tons of concentrate, and the total for the district since 1888 is probably less than 500 tons. Estimates of the probable grade of minable material show a wide range depending largely on the assumed limits of the bodies. It has not been proven yet that bodies containing as much as several hundred thousand tons would yield more than 5 pounds of tin per ton. A detailed study of the district by Federal geologists is in progress.

Tin-bearing veins have been known in the Temescal district, Riverside County, California, since 1853 and nearly one million dollars has been spent since 1868 in three campaigns of exploration. As a result of a recent exhaustive study of the area that cost $20,000, it is revealed that there are probably several hundred outcropping veins, mostly 1 to 2 feet wide, which contain from 0.03 to 0.15 percent tin (0.6 to 3 pounds per ton). The only shoot that has justified mining (Cajalco Mine), produced, in 1890–92, 7,000 tons of crude ore that yielded about 150 tons of tin. When the mine was reopened in 1927–29, at a cost of several hundred thousand dollars, no more ore was found and the plant was dismantled.

Cassiterite was found in the Franklin Mountains, Texas, 15 miles north of El Paso, in 1899. From 1907–1910, four veins were extensively explored, mining, milling, and smelting plants erected at a cost of several hundred thousand dollars, and 8 tons of metallic tin, valued at $6,800, were produced. There is no record of the grade of the crude material, but estimates indicate about 1 percent tin across veins as much as 2 feet wide.

During 1890–92 and 1918–19, considerable work was done at a cost of several hundred thousand dollars on some tin-bearing veins within a 500-acre tract on Irish Creek, Rockbridge County, Va. In digging numerous shallow trenches, open-cuts, and tunnels, several thousand tons of crude ore were recovered, which, on milling, yielded less than 100 tons of concentrate. Federal geologists are now engaged in an examination of the deposits.

In addition to the comprehensive campaigns of exploration summarized above, some exploratory work has been done on tin-bearing deposits near Spokane, Wash.: Lander and Pershing Counties, Nev.; Catron County, N. Mex.; and Coosa County, Ala., but no ore has been shipped. Even though this work yields valuable information, most of which is recorded in official reports, it is not yet demonstrated that these districts are likely to contribute an appreciable production even at very high prices for tin.

The production of tin minerals in the United States and Alaska is not only small but seems to bear little relation to the prices offered for tin. Compared with the prices of other strategic metals, that for tin has fluctuated least during the last 30 years. The price was highest during the War, but if prevailing commodity prices are considered, index prices for tin have been higher in several post-War years. Sufficient information seems to be on hand concerning the tin content of the lode deposits of the United States to say that at the maximum index price of post-War years, no tin ore can be produced from them at a profit. At this price, however, Alaskan placer deposits will probably continue to yield a small production for many years.

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An estimate of the probable yield of the Alaska placers as well as domestic lodes at higher prices must be largely speculative because many unknown elements enter into consideration. The most dependable information concerning known lode deposits indicates that most of the proven material contains from 0.03 to 0.50 percent tin (0.6 to 10.0 pounds of tin per ton) and that material of higher grade is small in quantity and highly sporadic, both locally and throughout the entire country. The following estimates of production attempt to take into account all that is now recorded concerning the number, distribution, grade of domestic deposits, and the costs that are inherent in existing technique of mining and recovery.

*Potential production of tin in the United States at assumed index prices of $0.50 and $1.00 per pound, in long tons*

| Assumed index price | Potential production | | |
|---|---|---|---|
| | Alaskan placers | Domestic lodes | Total |
| $0.50 per pound: | | | |
| First year | 150–300 | 0–10 | 150–310 |
| Second year | 150–300 | 0–10 | 150–310 |
| Third year | 150–300 | 0–10 | 150–310 |
| $1.00 per pound: | | | |
| First year | 250–500 | 10–50 | 260–550 |
| Second year | 500–1,000 | 200–500 | 700–1,500 |
| Third year | 1,000–2,000 | 500–1,000 | 1,500–3,000 |

It should be emphasized again that many speculative elements enter into these estimates and that they indicate only the order of magnitude of what may be expected.

Unless some unforeseen new major discovery is made it is evident that the United States must continue to rely on foreign sources of tin and that encouragement of domestic production offers little hope of providing national security in tin.

*Domestic smelting industry.*—It has been stated that, from the standpoint of national defense, the establishment of a permanent smelting industry in the United States is advantageous for two reasons. First, it would increase the normal stocks of tin, because the smelters would maintain reserve supplies of ore and finished metal and in addition there would be tin in process of smelting. Second, it would eliminate part of the danger arising from our dependence on foreign smelters, all of which are vulnerable to aerial bombardment. These advantages, however, hardly compare with the security afforded by advance purchase of reserve stock piles as recommended by the President's Committee for Mineral Policy.

Such stocks as would be required to maintain a domestic smelting industry would be relatively small in terms of national requirements. At present, consumer stocks are exceptionally high, yet they are equivalent to only a 3-month supply at a normal rate of consumption. Usually they are adequate for less than 1 month's operation. A smelting industry probably would not add more than an additional 2-month supply, which does not go far in guaranteeing tin requirements for a 2-, 3-, or even 4-year emergency.

Although it is true that smelters could be so situated in the United States as to be relatively safe from aerial attacks they would still have to depend on distant ore-producing centers. Bolivia's peak output in 1929 was equivalent to only 55 percent of the tin consumed in the United States in that year. Assuming that the entire Bolivian produc-

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tion could be smelted domestically, large tonnages of ore would have to be obtained from oversea sources. Moreover, from a strategic point of view the United States would be worse off dependent on ore imports than on metal imports, as the situation is now. The greater weight of ore compared with metal would aggravate the transportation problem, and since the principal weakness of our present tin position lies in the danger of our lines of communication being cut off, any increase in volume of traffic is undesirable.

During the World War extraordinary conditions developed in the tin trade that made it desirable to smelt Bolivian tin ores in the United States. With resumption of normal conditions after the war, the domestic smelting industry could not compete with foreign smelters and was forced to discontinue operations. The record shows that smelting costs were higher in the United States than in the United Kingdom and Germany, principally on account of higher labor costs.[6] It is therefore evident that if a smelting industry is to be created it can be established only by increasing the cost of tin to American consumers. This cannot be justified on the basis of national defense, owing to the questionable benefits of a domestic smelting industry in time of war.

*Substitutes and restrictions.*—In an emergency during which the tin supply might be cut off the use of tin could be reduced considerably by substitution and restriction, but at a terrific cost in terms of industrial efficiency. The introduction of substitutes always entails delay and confusion and should be avoided as much as possible when industry is being mobilized for war. Peacetime development of substitutes for our deficient raw materials should be encouraged, but their acceptance by industry should be predicated only on the basis of lower costs or better performance. Industry should not be deprived of a metal possessing such useful properties as tin in times of peace merely as a precaution against shortage in a war emergency that can be provided for so simply and so cheaply by accumulation of a reserve stock pile. Large scale substitution for tin in time of war should be considered only as an extreme measure.

*Stock piles favored by Army and Navy.*—For several years the Army and Navy have been advocating stock piles as the logical solution of the national defense problem arising from our deficiency in certain strategic raw materials. The advantages of this method were summarized ably by Capt. F. A. Daubin, United States Navy, Chief, War Procurement Planning Section, office of Chief of Naval Operations, in his testimony before the House of Representatives, Committee on Military Affairs, in March 1939. Captain Daubin stated:

> The importance to the Navy and the national defense of the acquisition of stock piles of these materials may be stated briefly as follows:
>
> The physical possession of adequate reserves of strategic raw materials would afford the United States important advantages, political and military.
>
> As a neutral—it would make us independent of the favors of belligerents who may control the sources of these materials, thereby making simpler the maintenance of neutrality.
>
> As a belligerent—it would insure a ready supply of materials needed by our industrial facilities to produce an uninterrupted supply of munitions so vital at the outset of war when communications are likely to be temporarily disrupted.
>
> Meanwhile, time would be afforded to develop available domestic sources or to find substitutes.

[6] Mineral Industry, 1923 (p. 671) and Tariff Information, 1921: Hearings on General Tariff Revision before Committee on Ways and Means, House of Representatives, 1921, pt. II, p. 1057.

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It would free us from the necessity of providing ships to transport these materials at a time when ships would be at a premium.
It would free our fleet from the necessity of patrolling the sea lanes involved in such transportation.
It would make ineffective raw material sanctions which may be directed against us by other countries.

The principle of accumulating stock piles as insurance against a war emergency was first accepted officially in the Navy Department appropriation bill for the fiscal year 1938, when $3,500,000 was provided for the purchase of strategic raw materials. An additional $500,000 was appropriated for 1939, and $500,000 is included in the bill for 1940, now pending. The Navy has acquired a small reserve supply of tin and other commodities with this money, but the amount on hand is very small in terms of national requirements.

In an address entitled "Strategic Minerals in the United States," presented at the annual convention of the American Zinc Institute in St. Louis in April 1938, Dr. John W. Finch, Director of the Bureau of Mines, proposed the following two-point program for attacking our deficiency mineral program.

1. The immediate purchase of adequate stock piles of strategic minerals of standard quality as the most effective means of meeting the pressing problems of national defense.
2. The annual appropriation by the Government of $500,000 to be used by the Bureau of Mines and the Geological Survey for the purpose of a comprehensive study of ways and means of adapting our domestic reserves of strategic minerals to a permanent solution of our deficiency mineral problem.

Although there is little hope for tin under point (2), it is gratifying to note that legislation on this subject now pending before Congress, and mentioned in the general summary of this chapter, closely parallels Dr. Finch's constructive program. The funds provided in the various bills are inadequate to supply all the stock-pile requirements, but the impending passage of a bill along these lines indicates that the United States is about to initiate action that eventually may remove the threat to national defense inherent in our dependence on foreign sources of tin and other strategic commodities.

## DOMESTIC PRODUCTION

*Primary tin.*—Mine output of tin in 1938 is estimated at 109 long tons, a decline of 35 percent from the peak of 1937. As usual, Alaska produced virtually all (108 tons) of it; South Dakota contributed only 1 ton.

According to the Geological Survey:

Tin mining in Alaska in 1938 was confined mainly to the placer deposits that have been developed in the extreme western part of Seward Peninsula. Mining in this area has been in progress for a number of years and lately has been decidedly on the increase. In 1938, however, judging from the preliminary reports that have been received, the output of placer tin from this area dropped off somewhat from the high rate established in 1937 but still remained above that of any other year in the entire period during which tin mining has been in progress. Owing to the much lower price that prevailed for tin in 1938, as well as the somewhat smaller quantity produced in that year, the total value of the tin output of Alaska is estimated to have been worth about $100,000 less than in the preceding year.

In South Dakota the Fansteel Mining Corporation operated the Bear Creek mine near Tinton during 1938 and sold a mixed concentrate from which 2,500 pounds of tin ore, containing 1,450 pounds of

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tin, was obtained. Two other operators reported production of small quantities of tin concentrates from the same region, but apparently the ore was not sold.

*Mine production of tin (content) in the United States, 1910–38, by States*

| Year | Long tons | | | | Value |
|---|---|---|---|---|---|
| | Alaska | South Dakota | Other States [1] | Total | |
| 1910 | 9 | 17 | 10 | 36 | $23,447 |
| 1911 | 54 | (2) | (2) | 63 | 56,635 |
| 1912 | 116 | | | 116 | 124,800 |
| 1913 | 45 | 1 | 3 | 49 | 46,699 |
| 1914 | 93 | | | 93 | 66,560 |
| 1915 | 91 | | | 91 | 78,846 |
| 1916 | 124 | | 1 | 125 | 122,000 |
| 1917 | 89 | 9 | | 98 | 135,600 |
| 1918 | 61 | .1 | .9 | 62 | 118,500 |
| 1919 | 50 | | | 50 | 73,400 |
| 1920 | 14 | 6 | | 20 | 22,000 |
| 1921 | 3.6 | | | 3.6 | 2,400 |
| 1922 | 1.3 | | | 1.3 | 912 |
| 1923 | 1.7 | | | 1.7 | 1,623 |
| 1924 | 6.3 | | | 6.3 | 7,028 |
| 1925 | 12.3 | | | 12.3 | 15,980 |
| 1926 | 7.1 | | | 7.1 | 10,400 |
| 1927 | 23.9 | .1 | | 24 | 34,600 |
| 1928 | 36.6 | 1.8 | 3.6 | 42 | 47,400 |
| 1929 | 34.5 | .2 | .3 | 35 | 35,600 |
| 1930 | 13.1 | .2 | 1.7 | 15 | 10,500 |
| 1931 | 3.6 | .1 | | 3.7 | 2,050 |
| 1932 | | .4 | | .4 | 220 |
| 1933 | 2.6 | .1 | | 2.7 | 2,400 |
| 1934 | 8 | .2 | | 8.2 | 9,600 |
| 1935 | 44.1 | .4 | | 44.5 | 50,200 |
| 1936 | 101 | (3) | | 101 | 105,000 |
| 1937 | 166 | .8 | 1.6 | 168.4 | 205,300 |
| 1938 | [4] 108 | 1 | | [4] 109 | [4] 103,200 |

[1] California, North Carolina, South Carolina, Texas, and Wyoming.
[2] Figures not available.
[3] Less than 0.1 ton.
[4] Subject to revision.

*Secondary tin.*—Production of secondary tin declined 22 percent in 1938 as a result of the decreased consumption of virgin metal. A very large part of the secondary tin produced in the United States is recovered from industrial scrap, and curtailment in tin-manufacturing operations is reflected immediately in secondary production figures. Further details on secondary tin in 1938 are given in the chapter on Secondary Metals (Nonferrous).

*Secondary tin recovered in the United States, 1925–29 (average) and 1934–38* [1]

| Year | Tin recovered at detinning plants | | | Tin recovered from all sources | | | |
|---|---|---|---|---|---|---|---|
| | As metal (long tons) | In chemicals (long tons) | Total (long tons) | As metal (long tons) | In alloys and chemicals (long tons) | Total | |
| | | | | | | Long tons | Value |
| 1925–29 (average) | 900 | 2,000 | 2,900 | 7,500 | 23,100 | 30,600 | $38,034,120 |
| 1934 | 900 | 1,800 | 2,700 | 7,300 | 14,900 | 22,200 | 25,487,600 |
| 1935 | 1,100 | 2,200 | 3,300 | 8,600 | 16,300 | 24,900 | 27,498,200 |
| 1936 | 2,300 | 1,500 | 3,800 | 6,500 | 18,500 | 25,000 | 25,621,500 |
| 1937 | 2,500 | 1,500 | 4,000 | 7,400 | 19,700 | 27,100 | 32,124,100 |
| 1938 | 2,200 | 1,300 | 3,500 | 4,300 | 16,700 | 21,000 | 19,284,600 |

[1] Figures compiled by J. P. Dunlop, of the Bureau of Mines.



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## CONSUMPTION

*Apparent consumption.*—The accompanying table shows the apparent consumption of primary metallic tin in the United States from 1910 to 1938, inclusive. These data do not consider the fluctuations in dealer and consumer stocks, information on which is not always available, consequently they do not reveal precisely the actual trend in consumption. Nevertheless, statistics on apparent consumption are useful in determining long-time trends.

The table shows that apparent consumption reached a peak in 1937 but declined 44 percent in 1938. The figure for 1937, however, exaggerates actual consumption, as there were large accretions to consumers' stocks in that year; 1929 thus stands as the year of maximum tin consumption in the United States.

*Production, imports, exports, and apparent consumption of tin in the United States, 1910–38, in long tons*

| Year | Smelter production | Imports for consumption | Exports (domestic and foreign) | Apparent consumption |
|---|---|---|---|---|
| 1910 | | 46,900 | | 46,900 |
| 1911 | | 47,792 | | 47,792 |
| 1912 | | 51,800 | | 51,800 |
| 1913 | | 46,722 | | 46,722 |
| 1914 | | 42,438 | | 42,438 |
| 1915 | | 51,600 | 341 | 51,259 |
| 1916 | 2,019 | 61,638 | 449 | 63,208 |
| 1917 | 5,415 | 64,434 | 263 | 69,586 |
| 1918 | 9,182 | 63,620 | 254 | 72,548 |
| 1919 | 10,925 | 40,044 | 341 | 50,628 |
| 1920 | 15,761 | 56,067 | 927 | 70,901 |
| 1921 | 10,305 | 24,197 | 1,393 | 33,109 |
| 1922 | 8,132 | 60,193 | 1,098 | 67,227 |
| 1923 | 6,666 | 68,934 | 1,046 | 74,554 |
| 1924 | 434 | 65,059 | 959 | 64,534 |
| 1925 | | 76,646 | 932 | 75,714 |
| 1926 | | 77,159 | 1,980 | 75,179 |
| 1927 | | 71,142 | 2,239 | 68,903 |
| 1928 | | 77,970 | 1,617 | 76,353 |
| 1929 | | 87,127 | 1,930 | 85,197 |
| 1930 | | 80,734 | 2,233 | 78,501 |
| 1931 | | 66,064 | [1] 1,661 | 64,403 |
| 1932 | | 34,819 | [1] 1,117 | 33,702 |
| 1933 | | 63,718 | [1] 1,041 | 62,677 |
| 1934 | | 39,986 | [1] 1,216 | 38,770 |
| 1935 | | 64,258 | [1] 2,292 | 61,966 |
| 1936 | | 76,029 | [1] 386 | 75,643 |
| 1937 | | 88,115 | [1] 313 | 87,802 |
| 1938 | | 49,699 | [1] 205 | 49,494 |

[1] Foreign only, 1931–38; domestic not separately recorded.

*Consumption by uses.*—The following tables show actual consumption of primary and secondary tin by uses, as reported to the Bureau of Mines. Except for tin plate and terneplate figures for 1938 were not available at the time this manuscript was prepared. The data represent the products of the first cycle of manufacture; and, for the purpose of this canvass, any virgin tin emerging from this stage as scrap is considered as secondary metal. The figures thus understate consumption of primary tin, and much of the secondary tin shown duplicates data on the virgin metal because it is metal reclaimed from such byproducts as tin-plate clippings and virgin drosses from tin-plate and tinning mills and other plants consuming virgin tin. In 1937, for example, domestic consumers purchased 82,946 tons of virgin metal, of which 7,523 tons was added to inventories and 75,423

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tons processed. Of the tin processed 72,928 tons emerged from the first stage of manufacture in the products shown in the accompanying tables; and 2,495 tons was sold as scrap, was lost, or was added to stocks of metal in process.

*Consumption of primary and secondary tin in the United States, 1935–37, in long tons*

| | 1935 | 1936 | 1937 |
|---|---|---|---|
| Stocks on hand Jan. 1 | 16,920 | 14,981 | 17,978 |
| Net purchases during year [1] | 71,392 | 89,232 | 101,354 |
| Available supply | 88,312 | 104,213 | 119,332 |
| Stocks on hand Dec. 31 | 14,981 | 17,978 | 25,984 |
| Total processed during year | 73,331 | 86,235 | 93,348 |
| Intercompany transactions in scrap (tin content) | 1,805 | 2,827 | 2,782 |
| Total consumed in manufacturing | 71,526 | 83,408 | 90,566 |
| Plant losses | 353 | 358 | 436 |
| Tin content of manufactured products | 71,173 | 83,050 | 90,130 |
| Primary | 55,928 | 68,232 | 72,928 |
| Secondary | 15,245 | 14,818 | 17,202 |

[1] Includes in 1935—primary 55,584, secondary 2,218, terne 903, scrap 12,687; 1936—primary 73,137, secondary 2,176, terne 994, scrap 12,925; 1937—primary 82,946, secondary 3,461, terne 1,052, scrap 13,895.

*Consumption of tin in the United States, 1935–37, by finished products (tin content), in long tons*

| | 1935 | | | 1936 [1] | | | 1937 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Primary | Secondary | Total | Primary | Secondary | Total | Primary | Secondary | Total |
| Tin plate | 27,290 | | 27,290 | 33,750 | | 33,750 | 39,221 | | 39,221 |
| Terneplate | 208 | 856 | 1,064 | 369 | 943 | 1,312 | 382 | 1,015 | 1,397 |
| Solder | 9,734 | 6,910 | 16,644 | 12,068 | 6,682 | 18,750 | 12,026 | 7,832 | 19,858 |
| Babbitt | 3,667 | 1,485 | 5,152 | 5,070 | 1,609 | 6,679 | 4,501 | 2,272 | 6,773 |
| Bronze | 2,688 | 2,142 | 4,830 | 3,559 | 2,631 | 6,190 | 3,712 | 2,784 | 6,496 |
| Collapsible tubes | 3,548 | | 3,548 | 3,556 | | 3,556 | 3,571 | [3] | 3,571 |
| Tinning | 2,080 | 2 | 2,082 | 2,377 | 13 | 2,390 | 2,585 | 67 | 2,652 |
| Foil | 1,602 | 27 | 1,629 | 1,645 | 43 | 1,688 | 1,456 | 4 | 1,460 |
| Chemicals (other than tin oxide) | 693 | 2,579 | 3,272 | 209 | 1,346 | 1,555 | 171 | 1,331 | 1,502 |
| Pipe and tubing [2] | 950 | 3 | 953 | 1,401 | 82 | 1,483 | 1,278 | 18 | 1,296 |
| Tin oxide | 1,074 | 174 | 1,248 | 969 | 361 | 1,330 | 793 | 411 | 1,204 |
| Type metal | 165 | 859 | 1,024 | 253 | 919 | 1,172 | 221 | 1,140 | 1,361 |
| Galvanizing | 620 | | 620 | 1,016 | | 1,016 | 997 | [3] | 997 |
| Bar tin | 368 | 27 | 395 | 656 | 84 | 740 | 652 | 174 | 826 |
| Miscellaneous alloys | 422 | 60 | 482 | 418 | 62 | 480 | 482 | 24 | 506 |
| White metal | 347 | 50 | 397 | 358 | 9 | 367 | 374 | 33 | 407 |
| Miscellaneous | 472 | 71 | 543 | 558 | 34 | 592 | 506 | 97 | 603 |
| | 55,928 | 15,245 | 71,173 | 68,232 | 14,818 | 83,050 | 72,928 | 17,202 | 90,130 |

[1] Revised figures.
[2] In 1935 pure tin tubing required 940 tons and tin-lined tubing 13 tons; in 1936, 1,476 and 7 tons; in 1937, 1,286 and 10 tons.
[3] Small quantity included under "Miscellaneous."

The principal use of tin is in the manufacture of tin plate. Normally this industry consumes approximately half the virgin tin used in the United States. Production of tin plate declined 40 percent in 1938 compared with 1937. Although the food pack decreased only 10 percent, exports of tin plate fell 55 percent, and can makers drew heavily on inventories purchased before the price rise in 1937.

According to the American Bureau of Metal Statistics, the use of virgin tin in various other products decreased as follows in 1938: Solder, 34 percent; collapsible tubes and foil, 23 percent; babbitt, 38 percent; and bronze, 41 percent.

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A new process has been devised for coating copper, brass, and other metallic articles by suspending them in an atmosphere of hydrogen and stannous chloride vapor. The reduced tin alloys with the underlying metal, forming a close bond, and, in the case of copper, a hard tin-copper alloy surface. The process, known as "stannising," is said to be especially adapted to coating objects with an irregular surface, such as screws and bolts.

A. Strauss & Co., Ltd., of London, comments on the growth of substitutes for tin in the United States as follows:

One of the principal uses of tinfoil is the wrapping of cheese. Much of this will be discontinued in the future, and be replaced by a rubberized transparent paper. This substitution, it is stated, will effect a considerable saving in cost. Other changes in industrial processes are resulting in reduced tin consumption. A lead bearing metal, free of tin, is being used in the production of certain automobiles. Substitutes are being increasingly used for tin oxide. The move towards the use of tooth powder instead of tooth paste, brought about by a nation-wide advertising campaign, is diminishing the demand for tooth paste tubes. The increasing popularity of electric shavers is decreasing the sale of shaving cream tubes. Aluminum is now being more freely used in the manufacture of tubes, in view of the high tin price. The tinplate industry still remains, of course, the backbone of tin consumption, but even here new processes are in operation by which the coating of metal has been reduced. An interesting development which may well have some adverse effect on the sale of tinned fruit and vegetables is the new method of refrigeration adopted by the railroad companies. They can now carry to the North throughout the winter fresh vegetables from the South at a figure very slightly above the price of tinned vegetables. The total effect of these developments and substitutions is not serious; they are mentioned as evidence of a tendency.

## FOREIGN TRADE [7]

The principal items in the foreign trade of the United States in tin are imports of pig tin, which supply virtually all the domestic tin requirements, and exports of tin plate. Of minor importance are the import and export trade in tin-plate scrap, exports of tin-plate circles, strips, cobbles, etc., and exports of waste-waste tin plate. There is also an appreciable export of miscellaneous tin manufactures, tin-plated hollow ware, and tin compounds. Virtually all the trivial domestic output of tin ore is exported, and a small quantity of ore is imported annually.

Metallic tin imported for consumption declined 44 percent from the all-time peak established in 1937. Eighty-seven percent of the total imports came from Asia, 12 percent from Europe, and 1 percent elsewhere. Receipts from all major producing areas declined in 1938.

*Foreign trade of the United States in tin and tin concentrates, 1934–38*

| Year | Imports | | | | Exports of tin (metal) [1] (long tons) |
|---|---|---|---|---|---|
| | Tin (metal) | | Tin concentrates (tin content) | | |
| | Long tons | Value | Long tons | Value | |
| 1934 | 39,986 | $44,800,650 | 2 | $859 | 1,216 |
| 1935 | 64,258 | 69,815,287 | 178 | 106,078 | 2,292 |
| 1936 | 76,029 | 75,450,941 | 179 | 94,738 | 386 |
| 1937 | 88,115 | 104,284,762 | 151 | 132,810 | 313 |
| 1938 | 49,699 | 44,860,324 | [2] | 298 | 205 |

[1] Imported as pigs, bars, etc., and exported as such.
[2] Less than 1 ton.

[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Tin [1] imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Long tons | Value | Long tons | Value |
| Argentina | 130 | $164.377 | 482 | $437,762 |
| Australia | 95 | 60,214 | 130 | 126.914 |
| Belgian Congo | 190 | 246,418 | 75 | 77.376 |
| Belgium | 120 | 171,463 | 395 | 394,518 |
| Bolivia | 112 | 137,335 | 25 | 22,355 |
| British Malaya | 66,709 | 79,490,432 | 36,673 | 32,952,813 |
| Canada | 47 | 53,897 | 11 | 8,908 |
| China | 4,467 | 5,126,838 | 2,084 | 1,807,756 |
| Cuba | | | 1 | 481 |
| Germany | | | 20 | 17,109 |
| Hong Kong | 2,068 | 2,222,866 | 1,204 | 1,034,384 |
| India, British | 200 | 208,602 | | |
| Indochina, French | 20 | 24.176 | | |
| Mexico | 201 | 193,856 | | |
| Netherland India | 4,105 | 4,793,256 | 3,096 | 2,716.274 |
| Netherlands | 2,447 | 2,958,631 | 2,216 | 2,062,990 |
| Sweden | | | [2] | 15 |
| United Kingdom | 7,204 | 8,432,401 | 3,287 | 3,200,669 |
| | 88,115 | 104,284,762 | 49,699 | 44,860,324 |

[1] Bars, pigs, blocks, grain, granulated, or scrap, and alloys, chief value tin, n. s. p. f.
[2] Less than 1 ton.

*Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1934–38, in long tons*

| Year | Tin-plate scrap | | Tin-plate circles, strips, cobbles, etc., exports | Waste-waste tin-plate, exports | Tin plate, taggers tin, and terneplate | |
|---|---|---|---|---|---|---|
| | Imports | Exports | | | Imports | Exports |
| 1934 | 7,868 | [1] | [1] | [1] | 126 | 184.651 |
| 1935 | 9,185 | 34,928 | [2] | [2] 24,525 | 187 | 134,499 |
| 1936 | 9,873 | 14,375 | [2] | [2] 44,621 | 233 | 238,880 |
| 1937 | 12,916 | 14,126 | 13,062 | 26,259 | 246 | 360,683 |
| 1938 | 10,444 | 12,495 | 4,467 | 7,255 | 109 | 161,578 |

[1] Data not available.
[2] Tin-plate circles, strips, cobbles, etc., included in waste-waste tin plate.

*Foreign trade in miscellaneous tin manufactures and tin compounds, 1934–38*

| Year | Miscellaneous tin manufactures | | Tin compounds (pounds) | |
|---|---|---|---|---|
| | Imports [1] | Exports [2] | Imports | Exports |
| 1934 | $55,525 | $677,266 | 200 | 202,777 |
| 1935 | 57,945 | 776,855 | 22 | 128,632 |
| 1936 | 73,114 | 1,295,484 | 5,959 | 344,578 |
| 1937 | 43,458 | 2,532,747 | 1,715 | 218,006 |
| 1938 | 11,468 | 2,064,504 | 865 | 172,467 |

[1] Tin manufactures n. s. p. f.
[2] Includes tin dross and tin-bearing scrap material other than tin-plate scrap.

The 55-percent decline in exports of tin plate, etc., in 1938 was greater than the decline in foreign consumption, indicating that domestic producers lost ground in the export market. Exports from the United Kingdom and Germany decreased only 29 and 12 percent, respectively.

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*Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1937–38, by principal countries and customs districts*

| Country and customs district | 1937 | | 1938 | |
|---|---|---|---|---|
| | Long tons | Value | Long tons | Value |
| COUNTRY | | | | |
| Argentina | 21,060 | $2,483,004 | 4,434 | $556,383 |
| Belgium | 4,627 | 517,930 | 1,005 | 111,145 |
| Brazil | 29,519 | 3,391,628 | 11,743 | 1,429,917 |
| British Malaya | 6,457 | 675,161 | 3,175 | 389,012 |
| Canada | 27,971 | 3,022,623 | 16,298 | 1,996,210 |
| Chile | 5,588 | 614,322 | 2,915 | 335,211 |
| China | 26,464 | 2,826,778 | 4,468 | 589,723 |
| Colombia | 4,371 | 495,571 | 2,332 | 296,381 |
| Cuba | 12,501 | 1,449,745 | 8,075 | 1,014,551 |
| Egypt | 3,847 | 402,530 | 2,429 | 249,686 |
| Hong Kong | 15,971 | 1,737,440 | 2,654 | 268,949 |
| India, British | 1,056 | 125,920 | 5,372 | 595,999 |
| Italy | 6,027 | 755,766 | 68 | 8,429 |
| Japan | 42,689 | 4,484,478 | 12,799 | 1,649,174 |
| Kwantung | 18,801 | 2,111,271 | 1,272 | 145,299 |
| Mexico | 13,842 | 1,614,326 | 8,646 | 1,049,305 |
| Netherland India | 6,038 | 639,283 | 4,192 | 452,890 |
| Netherlands | 15,861 | 1,926,995 | 12,093 | 1,487,499 |
| Norway | 8,664 | 859,373 | 2,499 | 265,487 |
| Peru | 4,495 | 499,846 | 3,099 | 351,811 |
| Philippine Islands | 12,848 | 1,383,517 | 8,940 | 991,154 |
| Portugal | 11,823 | 1,185,087 | 853 | 87,747 |
| Spain | 135 | 14,661 | 7,154 | 736,343 |
| Sweden | 8,962 | 903,285 | 3,871 | 400,781 |
| Syria | 3,094 | 331,802 | 2,433 | 257,337 |
| Turkey in Asia and Europe | 8,622 | 944,675 | 6,949 | 736,020 |
| Union of South Africa | 10,519 | 1,090,625 | 4,668 | 515,199 |
| U. S. S. R. | 7,890 | 1,023,453 | 5,660 | 775,304 |
| Uruguay | 10,011 | 1,170,515 | 4,567 | 562,579 |
| Other countries [1] | 10,930 | 1,258,312 | 6,915 | 772,416 |
| | 360,683 | 39,939,922 | 161,578 | 19,077,941 |
| CUSTOMS DISTRICTS | | | | |
| Buffalo | 10,461 | 1,092,787 | 1,582 | 185,389 |
| Chicago | 4,948 | 548,351 | 3,181 | 370,041 |
| Dakota | 3,501 | 436,070 | 6,481 | 867,323 |
| Maryland | 144,359 | 15,674,659 | 72,829 | 8,461,736 |
| Michigan | 5,466 | 557,337 | 4,984 | 564,271 |
| New York | 167,676 | 19,027,746 | 67,687 | 8,072,528 |
| Philadelphia | 15,460 | 1,699,328 | 2,938 | 331,334 |
| Other districts [1] | 8,812 | 903,644 | 1,896 | 225,319 |
| | 360,683 | 39,939,922 | 161,578 | 19,077,941 |

[1] Includes all exports not exceeding $250,000.

## PRICES

The average price of Straits tin in New York in 1938 was 22 percent below that of 1937, reacting to the industrial recession that began in the latter half of 1937 and continued into the first half of 1938. The tin quotation at the beginning of 1938 was 41.125 cents per pound. Minor fluctuations occurred during January and February, but toward the last of March a downward trend developed as business continued to lag. The low price for the year—35.00 cents—was recorded on May 2 following a period of uncertainty as to Malaya's position in regard to quota readjustments and buffer pool proposals. Improved deliveries during May, the announcement on June 1 that Malaya would join the buffer pool, and the decision to curtail production further during the third quarter had a pronounced effect on the tin market, and in June and July there was substantial recovery in prices. The following 2 months witnessed little change, but in the closing quarter quotations moved upward with the general improvement in industrial activity. On December 30 the price stood at 46.65 cents; the high for the year was 46.75 cents on December 29.

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*Tin price data, 1925–29 (average) and 1934–38*

| | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Average prices: | | | | | | |
| New York:[1] | | | | | | |
| Straits tin, cents per pound | 56.64 | 52.16 | 50.39 | 46.42 | 54.24 | 42.26 |
| 99.75-percent tin (English refined), do | (2) | 52.04 | 50.07 | 46.29 | 54.06 | 42.07 |
| 99-percent tin, do | 55.50 | 51.18 | 49.28 | 45.72 | 53.01 | 40.84 |
| London:[3] | | | | | | |
| Standard tin, £ per long ton | 254.6 | 230.4 | 225.7 | 204.6 | 242.3 | 189.6 |
| Do, cents per pound | 55.17 | 51.83 | 49.39 | 45.40 | 53.48 | 41.39 |
| Premium allowed over standard: | | | | | | |
| Straits, £ per long ton | 5.1 | 2.0 | 4.4 | 2.6 | 3.0 | 4.3 |
| Banka, do | 6.9 | 3.4 | 5.3 | 1.7 | ------ | ------ |
| English, do | —.7 | 1.1 | .5 | —.4 | .4 | 1.3 |
| Price indexes (1925–29 average=100): | | | | | | |
| Straits tin (New York) | 100 | 92 | 89 | 82 | 96 | 75 |
| Copper (New York) | 100 | 58 | 59 | 65 | 90 | 70 |
| Lead (New York) | 100 | 52 | 54 | 63 | 80 | 63 |
| Nonferrous metals[4] | 100 | 68 | 69 | 72 | 91 | 74 |
| All commodities[4] | 100 | 76 | 81 | 82 | 88 | 80 |

[1] American Metal Market.
[2] Data not available.
[3] Metal Bulletin, London, as compiled by International Tin Research and Development Council.
[4] Based on price indexes of United States Department of Labor.

*Monthly price of Straits tin for prompt delivery in New York, 1936–38, in cents per pound* [1]

| Month | 1936 | | | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|---|---|---|
| | High | Low | Average | High | Low | Average | High | Low | Average |
| January | 48.37½ | 46.00 | 47.24 | 51.50 | 49.80 | 50.89 | 42.87½ | 40.00 | 41.52 |
| February | 48.85 | 47.50 | 47.92 | 55.65 | 49.90 | 51.94 | 42.62½ | 40.50 | 41.27 |
| March | 48.87½ | 47.20 | 47.99 | 66.62½ | 54.10 | 62.71 | 42.00 | 38.00 | 41.15 |
| April | 47.62½ | 46.50 | 46.94 | 63.50 | 55.00 | 58.99 | 39.90 | 36.60 | 38.34 |
| May | 47.00 | 44.75 | 46.30 | 57.12½ | 54.62½ | 55.63 | 38.25 | 35.00 | 36.84 |
| June | 44.50 | 40.50 | 42.22 | 57.25 | 54.62½ | 55.84 | 43.00 | 37.50 | 40.35 |
| July | 44.75 | 40.50 | 42.97 | 60.25 | 57.50 | 59.31 | 44.25 | 42.60 | 43.37 |
| August | 43.30 | 42.00 | 42.57 | 60.37½ | 58.25 | 59.40 | 43.90 | 42.80 | 43.26 |
| September | 46.00 | 42.87½ | 44.74 | 59.87½ | 55.62½ | 58.62 | 44.50 | 42.65 | 43.38 |
| October | 46.37½ | 43.95 | 44.94 | 57.37½ | 47.62½ | 51.46 | 46.40 | 43.50 | 45.22 |
| November | 53.50 | 45.85 | 51.31 | 47.62½ | 41.00 | 43.30 | 46.70 | 45.60 | 46.23 |
| December | 52.85 | 50.62½ | 51.85 | 44.75 | 41.00 | 42.85 | 46.75 | 45.85 | 46.18 |
| Year | 53.50 | 40.50 | 46.42 | 66.62½ | 41.00 | 54.24 | 46.75 | 35.00 | 42.26 |

[1] Metal Statistics, 1939, pp. 379 and 381.

## STOCKS

Total stocks of virgin tin on hand in the United States at the end of 1938, and metal afloat, decreased 15 percent over 1937. Visible supplies—that is, afloat, at landings, or in licensed warehouses in New York—declined 34 percent during 1938, and stocks at consumers' plants were approximately the same at the beginning and end of the year. The total material on hand December 31, 1938, was equivalent to only a 6.5-month supply at the average rate of consumption in 1938.

World visible supply, exclusive of consumers' stocks, increased 21 percent, as shown in the accompanying table. These data do not include stocks of metal being accumulated by various countries as a reserve against a military emergency. The U. S. S. R. apparently stocked 20,000 to 25,000 tons for this purpose during 1937 and 1938.

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Recent sharp increases in tin shipments to Japan, Germany, Poland, and Sweden suggest that these countries, also, may be acquiring stock piles. The Navy Department of the United States Government had on hand, as of March 1939, an emergency reserve of 2,190 tons of tin.

*Stocks of virgin pig tin in the United States December 31, 1934–38, in long tons*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Location of stocks: | | | | | |
| Afloat to United States [1] | 4,002 | 7,650 | 10,857 | 7,678 | 4,150 |
| At landings in New York [1] | 1,585 | 2,192 | 4,990 | 4,106 | 1,837 |
| In licensed warehouses in New York [1] | 1,053 | 120 | 105 | 2,279 | 3,320 |
| Total visible supply [1] | 6,640 | 9,962 | 15,952 | 14,063 | 9,307 |
| Consumers' stocks [2] | 9,857 | 7,786 | 10,238 | 17,761 | [3] 17,800 |
| Total stocks on hand | 16,497 | 17,748 | 26,190 | 31,824 | 27,107 |

[1] As reported by Commodity Exchange, Inc.
[2] As reported to the Bureau of Mines; does not include tin in process or secondary pig tin.
[3] Partly estimated.

*Visible stocks of tin in the world and in the United States at end of each month, 1925–29 (average) and 1934–38, in long tons* [1]

| Month | 1925-29 (average) | | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | World[1] | U. S. | World[1] | U. S. | World[1] | U. S. | World[1] | U. S. | World[1] | U. S. | World[1] | U. S. |
| January | 18,912 | 2,986 | 28,724 | 8,209 | 18,535 | 2,581 | 17,233 | 2,985 | 26,179 | 5,478 | 27,101 | 4,866 |
| February | 19,620 | 3,027 | 28,296 | 7,014 | 23,426 | 3,571 | 17,562 | 3,525 | 23,774 | 4,956 | 25,261 | 5,116 |
| March | 18,312 | 2,803 | 25,010 | 6,459 | 22,165 | 4,531 | 18,664 | 3,968 | 24,127 | 5,731 | 29,125 | 4,458 |
| April | 17,765 | 2,189 | 22,886 | 5,649 | 20,324 | 4,295 | 16,869 | 2,713 | 24,593 | 4,741 | 30,606 | 4,447 |
| May | 19,085 | 2,384 | 21,580 | 5,089 | 19,074 | 4,930 | 18,380 | 2,941 | 23,721 | 5,144 | 27,909 | 3,679 |
| June | 18,250 | 2,390 | 20,587 | 5,094 | 16,221 | 5,467 | 16,448 | 3,054 | 23,291 | 4,810 | 29,061 | 4,247 |
| July | 18,164 | 2,675 | 20,939 | 6,461 | 16,173 | 3,227 | 16,759 | 2,151 | 25,646 | 6,193 | 31,097 | 4,071 |
| August | 18,339 | 2,450 | 19,676 | 4,968 | 16,306 | 2,681 | 17,642 | 3,095 | 26,016 | 5,850 | 32,251 | 5,232 |
| September | 18,317 | 2,425 | 18,833 | 4,243 | 14,564 | 2,849 | 16,896 | 2,860 | 23,014 | 3,538 | 32,476 | 4,573 |
| October | 18,356 | 2,899 | 20,624 | 4,998 | 16,138 | 1,389 | 19,048 | 3,315 | 22,865 | 3,280 | 31,539 | 4,500 |
| November | 19,058 | 2,373 | 19,239 | 4,048 | 16,804 | 1,472 | 23,148 | 3,030 | 24,389 | 5,285 | 30,598 | 5,060 |
| December | 20,557 | 2,277 | 18,172 | 2,638 | 15,318 | 2,312 | 23,787 | 5,095 | 27,044 | 6,385 | 30,554 | 5,157 |
| Average | 18,744 | 2,573 | 22,046 | 5,406 | 17,920 | 3,275 | 18,536 | 3,228 | 24,555 | 5,116 | 29,798 | 4,617 |

[1] Metal Statistics, 1939, pp. 369 and 371. Beginning January 1930, figures for world stocks include carry-over in the Straits Settlements (on lighters and warrants); beginning July 1933, they also include carry-over at Arnhem (Netherlands) smelter.

## WORLD ASPECTS OF TIN INDUSTRY

*International Tin Control Scheme.*—During the first quarter of the year countries signatory to the production-control scheme were operating under quotas representing 70 percent of standard tonnages, a sharp reduction from the 110 percent maintained during most of 1937. This curtailment was necessitated by the drop in demand the last 3 months of 1937. As business continued slack in 1938, production quotas were reduced to 55 percent for the second quarter and to 35 percent for the third and fourth quarters. Standard tonnages of Malaya and Netherland India were increased 7.5 percent effective July 1, 1938. Because this drastic curtailment by signatory countries was not met by the nonsignatory producers, the output of the latter rose to a proportion that would have permitted resignations from the Tin Control Scheme. The original agreement provides that when

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outside production "has, over a period of 6 consecutive months, exceeded 15 percent of the estimated world production during that period, or 12,500 tons of metallic tin, whichever is the less amount, it shall be competent for any territory to give 6 months' notice of its intention to withdraw from the Scheme." The right provided in the foregoing section was not exercised by any signatory country during 1938. According to E. Baliol Scott,[8] participants in the Buffer Stock Scheme contracted themselves out of this privilege.

The Buffer Stock Scheme proposed in 1937 was formally ratified and put into effect on July 1, 1938. The object of the scheme is to stabilize the price of tin. Limits of £200 and £230 per long ton (43.5 to 50.0 cents per pound with exchange at par, $4.8665) are provided, subject to change by resolution of the International Tin Committee (I. T. C.). The agreement provides for an initial stock of 10,000 tons, which can be increased to a maximum of "approximately 15,000 tons" by resolution of the I. T. C. The stock is to be administered by an executive who is in no way interested personally in the tin industry and who will be guided by general instructions issued from time to time by the I. T. C. In general, the operations of the executive are not to be revealed to any person other than the chairman of the I. T. C., but data on the quantity of tin held and the financial status are to be given to the I. T. C. where tin-control quotas are being considered. The original stock is to be supplied pro rata by members of the tin-control scheme, who likewise will participate pro rata in the proceeds from its sale. The agreement terminates on January 1, 1942.

The draft of the Buffer Pool Scheme was approved by the I. T. C. on March 14, 1938, and submitted to the signatory countries for ratification. Some objection to the scheme was encountered in Malaya, but on May 23 the plan was ratified by Malaya by a 2 to 1 vote. In June the I. T. C. established production quotas for the third quarter at 35 percent for the regular market trade and an additional 10 percent for the creation of the buffer stock. These percentages were reaffirmed for the last quarter of the year. R. G. Mills, a director of the Brazilian Warrant Agency & Finance Co., was appointed manager of the buffer pool in August. Details of the pool's activity during the last half of 1938 were not revealed, but apparently over 10,000 tons were accumulated by the end of the year. On November 22 the I. T. C. voted to increase the buffer stock to 15,000 tons. Production quotas for the first quarter of 1939 were retained at 35 percent for market and 10 percent for stock accumulations.

*World mine production.*—Mine production of tin decreased 30 percent in 1938 compared with 1937. Much of the decline was absorbed by the countries signatory to the International Tin Control Scheme, their output being decreased 33 percent compared with only 10 percent for the nonsignatory countries. British Malaya continued to be the largest producer and contributed 29 percent of the total world output. Bolivia ranked second with 17 percent, Netherland India third with 14 percent, Siam fourth with 9 percent, and China fifth with 8 percent. The output of the unrestricted producers comprised 19 percent of the total production in 1938 compared with 15 percent in 1937 and 11 percent from 1925 to 1929. There were no outstanding new producers in 1938.

[8] Scott, E. Baliol, Tin in 1938: Mining Jour. (London), Mar. 4, 1939, p. 165.

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*World production of tin (content of ore), 1925–29 (average) and 1934–38, by countries in long tons*

[Compiled by R. B. Miller

| Country | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Restricted production: | | | | | | |
| Belgian Congo | 967 | 3,654 | 5,301 | 6,301 | 8,942 | [1] 7,316 |
| Bolivia [1] | 37,169 | 22,857 | 25,007 | 24,052 | 25,128 | 25,484 |
| Indochina | 691 | 1,132 | 1,309 | 1,381 | 1,577 | 1,575 |
| Malay States: | | | | | | |
| Federated [1] | 54,606 | 36,385 | 40,780 | 64,719 | 75,393 | 41,077 |
| Unfederated | 2,206 | 1,239 | 1,542 | 1,979 | 2,075 | 1,961 |
| Straits Settlements | 25 | 51 | 52 | 58 | 72 | 99 |
| Netherland India | 33,266 | 19,680 | 20,140 | 30,728 | 39,165 | [1] 21,001 |
| Nigeria | 8,319 | 5,000 | 6,557 | 9,739 | 10,782 | [1] 7,305 |
| Portugal | (2) | 572 | 730 | 809 | (2) | (2) |
| Siam | 8,204 | 10,638 | 9,876 | [1] 12,526 | [1] 15,985 | [1] 13,616 |
| United Kingdom | (2) | 1,999 | 2,050 | 2,099 | (2) | (2) |
| Total signatory countries | 145,453 | 103,207 | 113,344 | 154,391 | 179,119 | 119,434 |
| Unrestricted production: | | | | | | |
| Argentina | 32 | 254 | 700 | 940 | 1,840 | [3] 1,800 |
| Australia | 2,830 | 2,986 | 3,130 | 3,361 | 3,607 | 3,150 |
| Burma | 2,228 | 4,061 | 4,102 | 4,546 | 4,636 | 3,800 |
| Cameroun, French | ---------- | 138 | 217 | 217 | 232 | 217 |
| China [1] | 7,085 | 6,386 | 9,078 | 11,123 | 12,871 | 11,606 |
| Germany | 98 | ---------- | 26 | 50 | [3] 100 | (4) |
| Italy | ---------- | ---------- | ---------- | 36 | 131 | 271 |
| Japan | 625 | 1,821 | 2,197 | 2,329 | [3] 2,257 | [3] 2,190 |
| Mexico | 2 | 16 | 621 | 368 | 373 | 249 |
| Morocco, French | 4 | 41 | 40 | 25 | 14 | 27 |
| Peru | ---------- | 1 | ---------- | 97 | 45 | 24 |
| Portugal | 625 | (3) | (3) | (3) | 1,095 | 764 |
| Portuguese East Africa | 5 | ---------- | 7 | 14 | 6 | (4) |
| Rhodesia: | | | | | | |
| Northern | ---------- | ---------- | 5 | 5 | 5 | 3 |
| Southern | 15 | 8 | 7 | 47 | 139 | 267 |
| South-West Africa | 149 | 136 | 164 | 162 | 169 | 164 |
| Spain | 145 | 230 | 300 | 104 | 127 | (4) |
| Swaziland | 138 | 114 | 127 | 128 | 108 | 113 |
| Tanganyika | 22 | 103 | 145 | 207 | 243 | [1] 263 |
| Uganda | 98 | 314 | 397 | 409 | 361 | 283 |
| Union of South Africa | 1,174 | 570 | 622 | 634 | 537 | 561 |
| United Kingdom | 2,658 | (3) | (3) | (3) | 1,987 | 1,930 |
| United States | 24 | 8 | 45 | 101 | 168 | 109 |
| Total nonsignatory countries | 17,957 | 17,187 | 21,930 | 24,903 | 31,051 | 28,000 |
| Grand total | 163,000 | 120,400 | 135,300 | 179,300 | 210,200 | 147,500 |

[1] Exports.
[2] See entry under "Unrestricted production."
[3] Estimated.
[4] Estimate included in total.
[5] See entry under "Restricted production."

*World smelter production.*—As considerable tin enters world trade in the form of ore, geographical data on world smelter output differs materially from those on mine output. For example, all ore from Bolivia and Nigeria is smelted in Europe. An appreciable part of the tin ore from Netherland India is smelted in the Netherlands, and the product of Siam and Indochina is smelted in British Malaya. The only commercial tin ore smelter in the Western Hemisphere is in Argentina, and its output has increased somewhat in recent years.

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*Smelter production of tin, 1925–29 (average) and 1934–38, in long tons*

[Compiled by R. B. Miller]

| Country | 1925–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Argentina | | 200 | 591 | 591 | 680 | (1) |
| Australia | 2,952 | 2,330 | 2,837 | 2,717 | 2,907 | (1) |
| Belgian Congo | | | 1,588 | 1,955 | 2,313 | (1) |
| Belgium [2] | 720 | 3,900 | 4,000 | 5,100 | 5,400 | (1) |
| British Malaya [3] | 88,855 | 49,637 | 60,479 | 84,591 | 95,372 | 63,746 |
| China | [4] 7,080 | 7,878 | 9,700 | 10,400 | 11,100 | [4] 11,606 |
| Germany [5] | 3,444 | 2,156 | 2,042 | 2,293 | 2,671 | (1) |
| Italy | | | 241 | 286 | 75 | 271 |
| Japan | 606 | 1,199 | 2,027 | 1,830 | 1,840 | (1) |
| Netherland India [4] | 14,749 | 10,506 | 11,221 | 12,854 | 13,757 | 7,208 |
| Netherlands [2] | [6] 1,000 | 13,400 | 15,600 | 20,900 | 26,600 | 25,560 |
| Norway | (1) | 174 | 454 | 233 | 241 | (1) |
| Portugal | [7] 2 | 39 | 1 | | | (1) |
| Siam | [8] 113 | (9) | (9) | | | (1) |
| United Kingdom [2] | 45,800 | 25,600 | 29,100 | 34,200 | 33,800 | 37,000 |
| | 165,000 | 117,000 | 140,000 | 178,000 | 196,800 | (1) |

[1] Data not yet available.
[2] Estimated.
[3] Exports plus difference between carry-over at end and beginning of year.
[4] Exports.
[5] Includes production of some secondary tin.
[6] Estimated production in 1929.
[7] Average for 1926–27.
[8] Average for 1926–28.
[9] Less than 1 ton.

*World consumption.*—Apparent world consumption of tin in 1938 decreased 24 percent from 1937, according to the International Tin Research and Development Council. This authority states that apparent consumption in the United States declined 41 percent compared with only 10 percent elsewhere. The principal consumers in 1938 and the percentage of the total each consumed were as follows: United States, 33 percent; United Kingdom, 12 percent; U. S. S. R., 11 percent; Germany, 9 percent; Japan, 7 percent; and France, 6 percent. Of these countries Germany and Japan were the only ones to use more tin in 1938 than in 1937. Italy also increased its tin consumption in 1938. The decline in consumption by the U. S. S. R. was due largely to completion of a stock-piling program mentioned elsewhere in this report.

*Apparent tin consumption of the world, 1926–29 (average) and 1934–38, by countries, in long tons* [1]

| Country | 1926–29 (average) | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Belgium | 1,231 | 1,219 | 1,250 | 1,336 | 1,520 | 1,618 |
| Canada | 2,346 | 1,786 | 2,086 | 2,164 | 2,625 | 2,355 |
| Czechoslovakia | 1,513 | 1,101 | 1,277 | 1,684 | 1,731 | 1,560 |
| France | 10,260 | 9,348 | 8,210 | 9,748 | 9,175 | 9,049 |
| Germany [2] | 12,444 | 10,658 | 11,083 | 9,164 | 12,392 | 13,474 |
| India, British | 2,704 | 2,222 | 2,541 | 2,293 | 2,595 | 2,494 |
| Italy | 4,268 | 4,118 | 6,641 | 3,642 | 3,584 | 4,618 |
| Japan | 4,506 | 5,190 | 6,221 | 6,403 | 8,190 | 10,963 |
| Netherlands | 980 | 1,090 | 1,232 | 1,284 | 1,470 | 1,400 |
| Poland | 589 | 739 | 907 | 1,322 | 1,272 | 1,819 |
| Spain | 1,565 | 1,519 | 1,713 | 826 | 942 | 1,082 |
| Sweden | 1,373 | 1,708 | 1,900 | 1,692 | 1,897 | 2,895 |
| Switzerland | 1,742 | 928 | 1,001 | 1,109 | 1,100 | 1,259 |
| United Kingdom | 21,988 | 21,073 | 21,427 | 21,860 | 25,971 | 18,290 |
| U. S. S. R. | 3,791 | 5,802 | 7,311 | 9,664 | 25,125 | 16,174 |
| United States | 76,539 | 43,638 | 62,470 | 73,039 | 86,663 | 50,724 |
| Other countries | 15,036 | 10,961 | 12,030 | 12,570 | 12,448 | 11,826 |
| | 162,875 | 123,100 | 149,300 | 159,800 | 198,700 | 151,600 |

[1] As estimated by the Tin Research and Development Council.
[2] Includes Austria; the Saar is also included after Feb. 17, 1935.

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## REVIEW BY COUNTRIES

*Argentina.*—In 1935, it was reported that the Patino, National Lead, and St. Joseph Lead Cos. jointly purchased a 10-year lease on a property in the neighborhood of Rio Rincanada, believed to contain 40,000 tons of tin. A smelter was erected in Buenos Aires. There has been a steady increase in production each year, and in 1938 the output of this property is believed to have reached about 1,700 tons of tin, of which approximately 1,200 tons were smelted in Buenos Aires, and the rest was shipped to Holland for treatment in the form of concentrates.

*Bolivia.*—Owing to the drastic reduction in export quotas in 1938, Bolivia could meet her allotment for the first time since 1933. In 1937 Bolivian exports were 24,373 tons below the permissible total, but in 1938 actual exports exceeded the quota by 3,516 tons. Production has been retarded by the shortage of manpower resulting from the war with Paraguay. Agitation to allot a larger share in exports to the Hochschild group was considered, and on October 4, 1938, a Presidential decree reduced Patino's share for the last quarter of 1938 from 50.34 to 46 percent and increased Hochschild's quota to 26 percent (from 18.8 percent). The decree assigned 5 percent to the Aramayo group, 13 percent to the medium-size producers, and 10 percent to the small miners (defined as those producing less than 60 tons in 1937). However, early in 1939 it was reported that Hochschild's quota was lowered by 5 percent and those of Patino and Aramayo raised 2 percent.

The October 4 action was predicated on the allegation that Patino's reserves are on the decline while Hochschild's reserves and producing capacity are increasing. The annual report of Patino Mines & Enterprises Consolidated, Inc., for 1937, contains the following statement by Patino: "The reduction in our reserves during the last 3 years is caused largely by the insufficiency in the number of workmen available." The proved reserves on December 31, 1937, were 59,291 tons. Patino also states that "Patino Mines and my own companies will always be ready to consider any proposal permitting the establishment of smelters in the United States, providing that the technical and economic difficulties which the project involves can be solved."

Of the 27,886 tons of Bolivian concentrates exported in 1938, 73 percent was treated in England; of the remainder, 26 percent was treated in Germany and Holland. The smelting of tin in Bolivia has been proposed from time to time, and several unsuccessful attempts to do so have been made in the past. These failures have been due to the refractory nature of Bolivian ores and the lack of a cheap fuel supply within the country. More recently, electrolytic methods have been emphasized, and Minerals Yearbook, 1938, called attention to the proposed erection of tin smelters at Oruro, using the Lamy electrolytic process. No further news regarding progress in this venture during 1938 has come to the attention of the Bureau of Mines.

A Supreme Resolution of September 16, 1938, definitely established Bolivia's participation in the Buffer Stock Scheme. The buffer stock formed in June 1934 became ineffective when Bolivia decided in June 1935 to terminate the agreement.

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*British Malaya.*—During the first half of 1938 British Malaya had an operative standard tonnage of 81,831 tons per annum, consisting of a standard allotment of 71,940 tons and 9,891 tons surrendered by or acquired from other producing countries. As of July 1, 1938, the surrendered and acquired tonnages became inoperative, but British Malaya's standard tonnage was increased 7.5 percent to 77,335 tons.

The 44-percent decline in Malaya's tin output in 1938 caused severe unemployment problems. The number of tin miners decreased from 88,285 at the beginning of 1938 to 57,663 at the end. Most of the idle workers were Chinese who had not returned to China owing to the Sino-Japanese War. To alleviate the situation, the Malayan Government is restricting immigration and accelerating public works to absorb labor on a large scale. It is also financing the production of additional ore above export quotas, which is to be stored and used later in meeting export allowances. Employers likewise are spreading the work to relieve unemployment.

Curtailment in production has been accomplished largely by stopping dredge operations. Normally, dredging is the principal means of ore production, but during several months in 1938 gravel pumping supplied the greater portion of the output. The future of tin mining in Malaya lies in the working of low-grade ground by dredges; and at present about 115 dredges are available. During the summer of 1937 as many as 95 of these were working, and several were being built or were on order. By the end of 1938, however, the number of active dredges had dropped to 55.

Comparatively speaking, Malaya enjoys an enviable position in the tin industry as a low-cost producer. Some operators believe that the production-control scheme has reacted to the detriment of Malayan producers and to the benefit of high-cost producers elsewhere. Sir John Bagnall, of Straits Trading Co., Ltd., for example, has suggested that Malaya would be better off with the greater employment that would result from a larger share in world production at a price of £100 for tin.[9]

For some time Malayan Government land policies have been criticized on the basis that prospecting was being stifled and that in consequence the tin reserve position was threatened. The Mines Department undertook a survey of reserves and issued an estimate of 1,000,000 tons of tin, representing only 10 years' life at the potential producing capacity of 100,000 tons per annum. Sir Lewis Fermor, formerly Director of the Geological Survey of India, was engaged to study the problem and to report to the High Commissioner. Although there were indications that the land restrictions would be eased, no definite action was taken during 1938.

*China.*—In December 1938, A. Strauss & Co., Ltd., reported that—

> The invasion of South China by the Japanese has stopped the exports from the Kwangsi and Kwangtung Provinces, which together amount to about 3,500 tons per annum. The only source of supply is now the Yunnan Province, whose production is approximately 9,000 tons. This metal is shipped via Haiphong. It would therefore appear that the export of about one-quarter of the Chinese tin has been affected by the Japanese invasion.[10]

[9] Mining Journal (London), vol. 201, No. 5355, Apr. 9, 1938, p. 375.
[10] Strauss, A., & Co., Ltd., London, and Strauss, Caswell, & Co., Inc., N. Y., Monthly Review of the Tin Market: November 1938.

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The Chinese tin-mining industry has been described by Ahlfeld in Metal und Erz for May 1938. An abstract in English is given in the London Mining Journal of June 11, 1938, page 566.

*Germany.*—Germany (including Austria) produces little tin; and, despite major efforts to provide substitutes, apparent consumption increased from 9,164 tons in 1936 to 13,474 in 1938. The acquisition of Czechoslovakia increased Germany's dependence on imported tin, as consumption there has averaged over 1,600 tons annually from 1936 to 1938, with little or no local production. In August 1938 it was reported that exploration in the lower levels of the old tin mines near Carlsbad, West Bohemia, disclosed large ore bodies containing about 1 percent tin. Production from this area, adequate for Czechoslovakia's needs, was expected. The ore was to be smelted in Germany. Details on developments since the Munich Agreement are not available.

Germany imported 6,045 tons of tin ore in 1938, of which 5,845 tons came from Bolivia. Imports of metallic tin (crude, scrap, and alloys) totaled 11,900 tons in 1938.

*Italy.*—Italy's tin requirements are supplied largely by imports of metallic tin, which amounted to 4,371 tons in 1938 and were obtained chiefly from British Malaya and neighboring European countries. The small production credited to Italy represents the output of two small mining operations and the tin recovered from scrap.

*Japan.*—Japan produces only a portion of its tin requirements, which have increased rapidly during the past 2 years. Most of the domestic ore has been smelted locally, but the product of some mines has been shipped to Singapore for treatment. To make Japan more self-sufficient in tin domestic production is being stimulated, and a tin property in Siam has been acquired by one of the larger Japanese companies. Smelting facilities are being increased to permit a larger proportion of imports in the form of ore. Recovery of secondary tin and use of substitutes are being encouraged, and distribution of the metal is controlled.

*Netherland India.*—Interest in the proposed merger of the Banka and Billiton operations, mentioned in Minerals Yearbook, 1938, appears to have waned in 1938. According to press reports, one reason for the proposed merger was to place the more aggresive management of Billiton in charge of operations at Banka, where mechanization and the development of low-grade reserves have lagged. In view of this statement the recent acquisition of large dredges by the Banka company is significant. Not only was the Kantoeng dredge, which was lost in the North Sea in 1937 en route to Netherland India, replaced with an even larger unit, but another large dredge was authorized by the Batavian Government. Considerable progress has been made in mechanizing other mining operations, and steam shovels and tractor scrapers are supplanting hand methods to a considerable extent.

In contrast to Banka, the Billiton company has 18 bucket dredges available. The recently completed Karimata dredge was temporarily engaged in dredging for treasure lost with the Lutine, which sank in the North Sea off the harbor of Terschelling at the end of the eighteenth century. When this unit arrives at Billiton, the company will have 14 dredges at this island and 4 at Singkep. Recent increases in capacity by the Banka and Billiton companies may have been

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inspired in part by a desire to improve the bargaining power of the Netherlanders in anticipation of negotiations for continuance of the present control scheme which expires at the end of 1941.

Although Billiton has more modern production facilities than Banka and can work lower-grade deposits, Banka has a much superior position in regard to grade and quantity of its tin reserves. Costs of production at Banka are thus considerably below those at Billiton.

During 1937 the operative tonnage of Netherland India under the Tin Control Scheme was 41,324 tons, including a standard allotment of 36,330 and 4,994 tons of acquired tonnage and carry-over. The acquired tonnage was surrendered as of July 1, 1938; but, effective the same date, the standard tonnage was increased 7.5 percent to 39,055 tons by the International Tin Committee. Exports of tin (content) amounted to 21,001 tons in 1938, of which 7,208 tons was metal and 13,793 tons was in tin content of ore. All the 18,700 tons of ore exported went to the Netherlands. Banka produced 12,545 tons and Billiton and Singkep 8,456 tons of the total tin exported.

*Netherlands.*—Production of tin at the Arnhem smelter decreased in 1938 from 26,600 to 25,560 tons and ore receipts from 39,600 to 38,200 tons. A substantial decline in ore shipments from Netherland India was partly offset by the larger tonnages from Bolivia and other countries. Of the total ore imports in 1938, 68 percent was derived from Netherland India, 28 percent from Bolivia, and 4 percent elsewhere. Exports of tin decreased from 25,300 tons in 1937 to 24,000 tons in 1938.

*Nigeria.*—The trade agreement signed by the United States and the United Kingdom on November 17, 1938, removes the 5-percent tax on exports of Nigerian tin ores shipped to the United States, effective January 1, 1939. This action is discussed further in the general summary at the beginning of this chapter.

The inability of Nigerian producers to meet their quota allotments in 1937 led to hurried attempts to increase capacity, and much machinery and other plant equipment previously ordered were installed during 1938, although it was not needed to meet the curtailed output for that year.

Total reserves of proved and probable ore, as compiled by the London Mining Journal (Nov. 26, 1938, p. 1092), amounted to approximately 123,000 tons (about 72 percent tin content) of which Associated Tin Mines of Nigeria, Ltd., and London Nigerian Tin Mines, Ltd., controlled 70 percent. Effective January 1, 1938, the managements of these companies were consolidated under Anglo-Oriental Nigeria, Ltd., and during the latter part of the year a complete merger into a new company called Amalgamated Tin Mines of Nigeria, Ltd., was proposed. This group contributed 5,566 of the 7,305 tons of tin exported from Nigeria in 1938. Nigerian concentrates are smelted in the United Kingdom.

*United Kingdom.*—Despite the drastic curtailment in mine production of tin throughout the world in 1938, British smelters increased their output over 9 percent. Imports of ore increased from 51,753 tons in 1937 to 55,553 in 1938. Of the 1938 total, 66 percent came from Bolivia, 20 percent from Nigeria, 9 percent from other British possessions, and 5 percent elsewhere. Receipts from Bolivia increased while those from Nigeria decreased in 1938. The decline in prices

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during 1938 forced some of the old tin mines in Cornwall to close. A plea was made to the Government for a subsidy to assist the Cornish industry, but it was denied.

*U. S. S. R.*—According to the International Tin Research and Development Council, apparent consumption of tin in the U. S. S. R. increased from an average of 7,600 tons in 1934-36 to 25,125 tons in 1937, then declined to 16,174 tons in 1938. These figures are based on tin shipments from producing countries. The larger shipments during 1937 and 1938 bear out press reports that the U. S. S. R. was accumulating a reserve stock of tin. Imports reported by the U. S. S. R. were 9,664 long tons in 1936, 12,309 tons in 1937, and 7,847 tons in 1938. Comparison of apparent consumption for 1937 and 1938 with previous years and with official Soviet import data indicates that 20,000 to 25,000 tons of tin may have been stocked for emergency use.

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# ARSENIC AND BISMUTH

By HERBERT A. FRANKE [1]

## SUMMARY OUTLINE


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## ARSENIC

Production of white arsenic in the United States declined only 1 percent in 1938 as a result of reduced activity at nonferrous smelters where all domestic arsenic is obtained as a byproduct. Imports dropped 26 percent, yet comprised 57 percent of the total apparent consumption, which decreased 28 percent. Although boll-weevil infestation in the Southern cotton fields was severe in 1938, low cotton prices restricted farmers' purchases of calcium arsenate and the financial situation of the railroads curtailed the use of sodium arsenite in weed killing. Lead arsenate requirements of the fruit industry were about normal in 1938. Of outstanding significance in insecticide consumption was the fight waged by Federal and State Governments against outbreaks of grasshoppers and Mormon crickets in the Western Great Plains States and the white-fringed beetle in the South. White arsenic quotations at New York remained at the low price of 3 cents per pound.

*Salient statistics for arsenic in the United States, 1925–29 (average) and 1935–38*

| | 1925–29 (average) | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| WHITE ARSENIC | | | | | |
| Domestic sales: [1] | | | | | |
| Crude, short tons | 2,364 | 6,985 | 8,755 | 10,903 | 9,428 |
| Refined, do | 10,035 | 5,685 | 6,826 | 6,733 | 3,732 |
| Imports for consumption, do | 10,769 | 15,075 | 17,586 | 19,256 | 14,238 |
| Apparent consumption [2], do | (3) | 26,945 | 32,167 | 34,692 | 25,098 |
| Average value for domestic sales: [1] | | | | | |
| Crude, cents per pound | 2.69 | 1.47 | 1.52 | 1.33 | 1.40 |
| Refined, do | 3.57 | 2.57 | 2.58 | 1.86 | 1.73 |
| OTHER ARSENICALS | | | | | |
| Imports for consumption: | | | | | |
| Metallic arsenic, pounds | 208,672 | 64,376 | 81,671 | 150,659 | 16,868 |
| Sulfide (orpiment and realgar), do | 575,506 | 710,967 | 355,463 | 502,418 | 241,602 |
| Arsenic acid ($H_3AsO_4$), do | 14,692 | 150 | 149 | 684 | 55 |
| Calcium arsenate, do | 1,452 | 182,900 | 817,200 | 796,243 | 400,000 |
| Lead arsenate, do | [4] 2,133 | ---------- | ---------- | 551 | ---------- |
| Sheep dip, do | 135,929 | 163,660 | 224,097 | 208,060 | 168,932 |
| Paris green and London purple, do | 4,402 | 38,085 | 33,207 | 108,825 | 103,556 |
| Sodium arsenate, do | 82,105 | 11,411 | 4,694 | 13,482 | 11,881 |
| Exports: | | | | | |
| Calcium arsenate, do | [5] 2,159,168 | 4,104,810 | 6,294,563 | 5,383,365 | 5,242,882 |
| Lead arsenate, do | [5] 1,328,828 | 1,156,922 | 827,560 | 1,042,880 | 1,021,345 |

[1] Includes sales by domestic producers for export.
[2] Adjusted for exports by domestic producers.
[3] Complete data not available.
[4] 10,467 pounds in 1925 and 200 pounds in 1929; no imports from 1926 to 1928, inclusive.
[5] Average for 1928–29; exports of calcium arsenate and lead arsenate not separately recorded by Bureau of Foreign and Domestic Commerce prior to 1928.

[1] Figures on imports and exports (except as indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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Although complete data on world arsenic production are not available, total output probably declined about 4 percent in 1938. As heretofore, Sweden was the largest world producer. The probable order of importance of other producing countries was as follows: United States, Mexico, France, Germany, Belgium, Australia, and Japan.

## PRODUCTION

Production and sales of white arsenic (arsenious oxide) in the United States in 1938 declined 1 and 25 percent, respectively, compared with 1937. Producers continued to market more of the crude than the refined product.

The three domestic producers in 1938 were American Smelting & Refining Co., Anaconda Copper Mining Co., and United States Smelting, Refining & Mining Co. The first of these placed a plant for the recovery of arsenic-bearing dust in operation at its El Paso (Tex.) smelter. This plant is expected to produce 56 to 60 tons of arsenic monthly.

*Crude and refined white arsenic produced and sold in the United States, 1934–38*

| Year | Crude | | | Refined | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Production (short tons) | Sales [1] | | Production (short tons) | Sales [1] | | Production (short tons) | Sales [1] | |
| | | Short tons | Value | | Short tons | Value | | Short tons | Value |
| 1934 | 8,997 | 9,030 | $425,680 | 4,099 | 6,593 | $371,598 | 13,096 | 15,623 | $797,278 |
| 1935 | 7,583 | 6,985 | 204,681 | 6,654 | 5,685 | 292,777 | 14,237 | 12,670 | 497,458 |
| 1936 | 9,937 | 8,755 | 266,113 | 5,442 | 6,826 | 352,713 | 15,379 | 15,581 | 618,826 |
| 1937 | 9,936 | 10,903 | 290,733 | 6,878 | 6,733 | 250,822 | 16,814 | 17,636 | 541,555 |
| 1938 | 12,619 | 9,428 | 264,004 | 4,066 | 3,732 | 129,018 | 16,685 | 13,160 | 393,022 |

[1] Includes sales by domestic producers for export.

Average receipts from sales in 1938 were 1.40 cents per pound for crude arsenic and 1.73 cents for refined arsenic, indicating a 5-percent increase from 1937 in the selling value of crude and a 7-percent reduction for refined arsenic.

Of the total sales in 1938, 72 percent was crude and 28 percent refined arsenic. In 1937 only 62 percent of the total sales was crude. All domestic crude arsenic was recovered as a byproduct from the smelting of lead and copper ores. Production, as reported by the Bureau of Mines, is measured after the low-grade flue dusts containing 20 to 30 percent $As_2O_3$ are subjected to a roasting or preliminary refining process. This crude arsenic usually contains 95 to 98 percent $As_2O_3$. Most of the crude arsenic and a small quantity of better-grade arsenic obtained in certain parts of smelter flue systems are marketed without further refining. Some crude arsenic is refined further. Bureau of Mines statistics on refined arsenic include products containing 99 percent or more $As_2O_3$. The arsenic reported as a refined product is not duplicated in the crude arsenic statistics.

## CONSUMPTION

The apparent consumption (sales plus imports minus approximate exports) of white arsenic in the United States in 1938 totaled 25,098

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short tons compared with 34,692 tons in 1937. Net imports were 48 percent of the 1938 consumption. In addition to white arsenic many other arsenic products were imported for consumption; details are shown in the table of salient statistics at the beginning of this chapter.

The distribution of sales of domestic arsenic in the United States in 1938 was approximately as follows: Insecticides, 47 percent; weed killer, 30; wood preservative, 3; glass manufacture, 2; and miscellaneous, 1. Exports comprised 17 percent of the domestic sales. Most of the white arsenic imported is used by insecticide manufacturers on the Atlantic and Pacific seaboards.

In 1937 production of calcium arsenate totaled 37,001,959 pounds (43,295,354 in 1935) and of lead arsenate 63,291,440 pounds (52,145,851 in 1935).[2] The production and consumption of calcium arsenate usually fluctuate much more than that of lead arsenate. Although consumption of the arsenicals lagged in 1938, use of calcium and lead arsenates in the United States increased approximately 275 and 245 percent, respectively from 1919 to 1936.[3] The use of insecticides has advanced owing to the increased numbers of the older insect species in the United States because of more intensive cultivation and planting and to the advent of new insect pests. The retail cost of all insecticides and fungicides sold in the United States is estimated to exceed $100,000,000 annually, and despite the warfare waged against them, insects and injurious fungi are believed to cause damage approximating $3,000,000,000 annually. Regulations to protect the consuming public require that foodstuffs not only be free from insects but of poisonous insecticidal residues. The latter requirement has stimulated some substitution of organic insecticides less toxic to man for poisonous arsenicals.[4] These new insecticides (rotenone, pyrethrum, etc.) cost more than arsenicals, and their use is not yet extensive from a tonnage standpoint. However, in combating the Mexican bean beetle, magnesium arsenate has largely been replaced by rotenone and deguelin insecticidal constituents derived from roots of the derris vine and cubé plant.

Data are not available on the total domestic consumption of the various arsenic insecticides and fungicides in 1938. The boll-weevil infestation was worse in the Gulf Coast States (Mississippi, Texas, Louisiana, and Alabama) and in Georgia in 1938 than in 1936 and 1937. Estimates (based on manufacturers' production) place calcium arsenate consumption at 45,000,000 pounds in 1936 and about half that quantity in 1937. However, large quantities of calcium arsenate often are purchased by dealers and farmers in anticipation of a serious boll-weevil infestation that does not occur, and this material is not consumed until a succeeding year. It is believed that in 1938 substantial quantities of left-over calcium arsenate were consumed and that farmers could not afford to purchase all necessary requirements because of the prevailing low cotton prices. Calcium arsenate also was used to kill cotton-leaf worms and white-fringed beetles in 1938. Lead arsenate is used regularly to exterminate fruit insects, and consumption in 1938 probably was about that in 1937 (44,000,000 pounds). A large quantity also was used to control Japanese beetles

[2] U. S. Department of Commerce Census of Manufactures: 1937.
[3] Roark, R. C., Insecticides and Fungicides, 1918–38: Chem. Ind., vol. 42, No. 6, June 1938, pp. 636–639.
[4] Roark, R. C., Agricultural Products as Insecticides: Ind. and Eng. Chem. (Ind. Ed.), vol. 31, No. 2, February 1939, pp. 168–171.
Woodbury, E. N., Advances in Entomology during 1938: Ind. and Eng. Chem. (News Ed.), vol. 17, No. 1, January 10, 1939, pp. 13–16.

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in the Eastern States. Paris green, another arsenical insecticide, was used in truck gardening.

During 1938 the Federal Government purchased and used 1,400,000 gallons of liquid sodium arsenite for grasshopper bait, 297,368 pounds of dry sodium arsenite to destroy Mormon crickets, and 35,000 pounds of calcium arsenate to kill white-fringed beetles. The Department of Agriculture estimates that in 1939 Federal arsenical purchases will exceed 2,100,000 gallons of liquid sodium arsenite, 447,000 pounds of dry sodium arsenite, and 792,000 pounds of calcium arsenate. These insecticides will be used to fight the annual grasshopper and Mormon cricket invasions west of the Mississippi River and to make a more determined stand against white-fringed beetles, newcomers in the Southern States since 1936.

Sheep dips for the extermination of parasites often are made with sodium arsenate, white arsenic, and arsenious sulfide.[5]

The drop in metallic arsenic imports also indicates a decrease in consumption in 1938 owing to the general decline in industrial activity. As in previous years the United States depended on German metal for all of its requirements. Importers of the metal include The Ore & Chemical Corporation, 80 Broad Street, and Pfaltz & Bauer, 305 5th Ave., both of New York, N. Y.; consumers of the metal include the National Lead Co., 111 Broadway, and the American Smelting & Refining Co., 120 Broadway, both of New York, N. Y. Most of the metallic arsenic is used as a metal hardener, as a flux, and in certain alloys. The addition of arsenic to lead-base bearing alloys helps prevent segregation and raises the hardness at both normal and elevated temperatures.[6] Arsenic in copper has a small hardening and strengthening effect, especially in the cold-worked condition, and raises the recrystallization temperature but is virtually without effect on ductility. It decreases the conductivity considerably. It occurs naturally in Lake copper and often is added to electrolytic copper in small amounts.

Arsenical compounds are being used more extensively in medicinal preparations. Among those used in fighting venereal diseases are arsphenamine, neoarsphenamine, sulfarsphenamine, and tryparsamide. The number of doses of arsenicals distributed by State health departments increased from 1,567,348 in the fiscal year 1937 to 2,799,110 in the 1938 fiscal period.

## PRICES

Domestic quotations for white arsenic at New York remained at the low price of 3 cents per pound, carload lots, throughout 1938. Quotations for less than carload lots were 3¾ cents per pound. In recent years white arsenic from foreign sources has enjoyed the benefit of depreciated European currencies and thus has offered considerable competition on both the eastern and western seaboards. The following table shows the slight fluctuations in the price of various arsenical compounds during 1937 and 1938.

[5] Mason, Charles F., Sheep Dips: Chem. Ind., vol. 44, No. 4, April 1939 (part 1), pp. 412, 414.
[6] American Society for Metals (Cleveland), Metals Handbook (1939 ed.): pp. 1394, 1554.

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*Range of quotations on arsenic and its compounds at New York (or delivered in East) 1937–38* [1]

| | 1937 (cents) | 1938 (cents) |
|---|---|---|
| Arsenic metal, lump, cases, per pound | 42.00–43.00 | 40.00–41.00 |
| White arsenic ($As_2O_3$), domestic, kegs, carlots, do | 3.00 | 3.00 |
| Red arsenic ($As_2S_2$), imported, cases, do | 15.75–16.25 | 15.75–16.50 |
| Calcium arsenate, wholesale, drums, carlots, do | 6.75 | 6.75– 7.25 |
| Lead arsenate, wholesale, drums, carlots, do | 11.50 | 11.00–13.00 |
| Sodium arsenate, wholesale, drums, do | 8.00 | 8.00 |
| Sodium arsenite (liquid), works, drums, per gallon | 30.00–33.00 | 30.00–35.00 |

[1] As reported by Oil, Paint, and Drug Reporter.

The low quotations given in the table often are dealers' prices. Delivered prices for most arsenicals vary in different sections of the United States.

Throughout 1938 the London quoted prices for Mexican (99 percent $As_2O_3$) and Swedish (99.5 percent $As_2O_3$) white arsenic remained at £10 5s. to £10 15s. per long ton and for Cornish arsenic (99 percent $As_2O_3$) at the nominal price of £12 per ton.

## FOREIGN TRADE

White arsenic imports in 1938 declined 26 percent compared with 1937, when imports were the highest ever recorded. Of the 1938 total, Mexico supplied 59, Sweden 20, France 8, Canada 5, Belgium 4, Japan 3, and Germany 1 percent. Imports from Mexico and Sweden decreased 27 and 42 percent, respectively, while those from France and Canada increased 42 and 15 percent, respectively.

Figures on imports of arsenical compounds other than white arsenic appear in the table of salient statistics. Imports of metallic arsenic in 1938 decreased 89 percent compared with those in 1937. Other percentage declines were: Arsenic sulfides 52, arsenic acid 92, calcium arsenate 50, sheep dip 19, paris green and London purple 5, and sodium arsenate 12 percent. All imports of metallic arsenic came from Germany and of calcium arsenate from Japan. Of the 241,602 pounds of arsenic sulfides imported, 144,622 came from Germany, 88,162 from Belgium, and 8,818 from France.

Official export data for white arsenic are not available, but reports of individual domestic producers indicate that about 2,300 tons were sold for export in 1938 compared with 2,200 tons in 1937. Exports of calcium and lead arsenate decreased 3 and 2 percent, respectively. Of the 5,242,882 pounds of calcium arsenate exported, 3,647,700 went to Peru, 1,040,308 to Colombia, 242,470 to Argentina, 75,964 to Mexico, and 65,500 to Chile. Of the 1,021,345 pounds of lead arsenate exported, 279,780 went to Argentina, 262,530 to the Union of South Africa, 122,104 to Chile, 107,561 to New Zealand, 61,716 to Cuba, and 42,280 to Mexico.

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*White arsenic imported for consumption in the United States, 1934–38, by countries*

| Country | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Australia | 39 | $1,494 | 56 | $2,334 | 690 | $30,500 | | | | |
| Belgium | 11 | 705 | 129 | 4,450 | 1,000 | 30,433 | 708 | $20,373 | 565 | $16,100 |
| Canada | 672 | 44,710 | 1,068 | 65,540 | 378 | 25,908 | 599 | 48,896 | 689 | 29,854 |
| France | 3,338 | 94,859 | 2,354 | 65,609 | 44 | 1,419 | 828 | 18,838 | 1,176 | 30,843 |
| Germany | 35 | 3,845 | 10 | 906 | 23 | 2,213 | 7 | 663 | 112 | 5,656 |
| Japan | 1,311 | 61,126 | 1,058 | 42,866 | 887 | 41,957 | 798 | 37,380 | 482 | 17,199 |
| Mexico | 8,704 | 500,970 | 9,274 | 525,140 | 8,174 | 426,590 | 11,500 | 556,097 | 8,422 | 415,180 |
| Sweden | | | 1,126 | 30,524 | 6,390 | 182,204 | 4,816 | 138,617 | 2,792 | 93,197 |
| | 14,110 | 707,709 | 15,075 | 737,369 | 17,586 | 741,224 | 19,256 | 820,864 | 14,238 | 608,029 |

## WORLD PRODUCTION

The world output of refined and marketable crude white arsenic in 1938 is estimated at 55,000 metric tons, a decline of 4 percent compared with the 57,000 tons estimated for 1937. The decrease is attributed to the decline in smelter activity in Mexico and a few other countries. A substantial quantity of nonmarketable crude arsenic also is produced annually but is discarded or stored for future refinement. Accurate production data are not available, since some countries fail to record arsenic statistics and others report only on sales or exports. Virtually all the world arsenic output is a byproduct from the treatment of gold, copper, lead, zinc, cobalt, silver, tungsten, and tin ores, and this is greater than demand.

*World production of white arsenic, 1934–38, by countries, in metric tons* [1]

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia: | | | | | |
| New South Wales | 632 | 376 | 124 | | [2] |
| Western Australia | 1,657 | 3,788 | 3,526 | 2,087 | [2] |
| Belgium-Luxemburg Economic Union [3] | 3,554 | 3,093 | 2,731 | 3,039 | 2,706 |
| Brazil | 700 | 696 | 732 | 717 | 519 |
| Canada | 747 | 1,161 | 619 | 630 | 987 |
| China | 1,206 | 1,200 | [4] | [2] | [2] |
| Chosen | 332 | 373 | 230 | | [2] |
| France | 8,599 | 5,887 | 9,750 | 6,501 | [2] |
| Germany [3] | 2,752 | 5,508 | 2,739 | 2,852 | 2,845 |
| Greece | 149 | 167 | 85 | | [2] |
| Japan | 2,734 | 3,161 | 2,629 | [2] | [2] |
| Mexico | 7,860 | 9,950 | 8,527 | 10,762 | 8,894 |
| Portugal | 40 | 73 | 186 | 21 | 1 |
| Southern Rhodesia | | | | | 19 |
| Sweden (sales) [5] | 7,405 | 6,350 | 8,647 | [2] | [2] |
| United Kingdom | 188 | 175 | 155 | 97 | 66 |
| United States | 11,880 | 12,916 | 13,952 | 15,253 | 15,136 |
| | 50,400 | 54,900 | 55,700 | [2] | [2] |

[1] Arsenic is also believed to be produced in Czechoslovakia, Peru, Rumania, Turkey, and the U. S. S. R. Production figures are not available for these countries.
[2] Data not available.
[3] Exports.
[4] Data not available. Estimate included in total.
[5] Arsenic content of ores mined is as follows: 1934, 28,618 tons; 1935, 24,418 tons; 1936, 23,312 tons; and 1937 20,954 tons.

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*Belgium.*—Arsenic is a byproduct of the lead and zinc smelters of the Société Générale Métallurgique de Hoboken at Hoboken and of the Société Métallurgique d' Overpelt-Lommel at Overpelt. Of the 2,707 metric tons of white arsenic exported in 1938, 1,050 went to the United Kingdom, 632 to the United States, 255 to Argentina, 228 to Germany, 149 to Brazil, and 54 to the Union of South Africa.

*Canada.*—In 1938 Canada exported 1,378,300 pounds of arsenic (not otherwise specified) to the United States. Canada produces a granular variety of white arsenic used by the glass industry.

*France.*—Unconfirmed reports state that metallic arsenic recently began to be produced in France. French imports in 1938 included 18 metric tons of arsenic metal (21 in 1937) and 12 tons of white arsenic (21 in 1937); exports included 0.6 ton of arsenic metal (none in 1937) and 2,910 tons of white arsenic (4,245 in 1937).

*Germany.*—Bigot, Schaerfe & Co. Chemische Fabrik G. m b. H. at Hamburg produces metallic arsenic, much of which is exported. Imports of white arsenic totaled 617 metric tons in 1938 (557 in 1937). Of the 1938 imports, 312 tons came from Sweden, 215 from Belgium, and 89 from France; of the exports (2,845 tons) 514 tons went to Brazil, 335 to Turkey, 298 to the Netherlands, 288 to Denmark, 211 to Belgium, 178 to Spain, 173 to Argentina, and 144 to Hungary.

*Mexico.*—Arsenic and bismuth were among the commodities assessed the additional "export" tax, effective August 9, 1938. A production tax but not the regular export duty also is levied on these commodities. The new additional "export" tax amounts to 12 percent of the value as fixed by the commodity committee; in February 1939 the value placed on arsenic was 0.278 peso and on bismuth 11.343 pesos per gross kilo. The American Metal Co., Ltd., annually exports and distributes substantial quantities of white arsenic in the United States. Of the 8,854 metric tons of arsenic exported from Mexico in 1938 (10,695 in 1937), 8,424 tons went to the United States, 415 to the United Kingdom, and 15 to Germany.

*Sweden.*—Bolidens Gruv A.-B., the largest arsenic producer in the world, is constructing a number of round silos at Rönnskär for the storage of more arsenic. The company maintains a laboratory at Stockholm for research on new uses for arsenic and has achieved some success in the fields of insecticides, timber preservation, and corrosion-resistant concrete. A "Boliden impregnating salt" gradually is displacing imported creosote in Sweden and is used to preserve telephone poles, railroad ties, piles, mine timber, etc.

*United Kingdom.*—Imports of white arsenic totaled 4,359 long tons in 1937—2,211 tons from Sweden, 592 from Belgium, 564 from France, 448 from Mexico, and 100 from the United States.

## BISMUTH

Data on the production of bismuth in the United States are lacking. Consumption probably remained about the same in 1938 as in 1937. As usual, pharmaceutical and alloy manufacturers consumed most of the bismuth. The use of bismuth and arsenical compounds in fighting venereal diseases increased. The price for bismuth metal advanced on April 25, 1938, from $1 to $1.05 in New York and from 4s. to 4s. 3d. per pound in London. In March 1939 the price was increased further to $1.10 and to 4s. 6d. per pound. Bismuth imports increased

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37 percent in 1938, and unofficial data indicate that exports dropped sharply compared with 1937.

## PRODUCTION

The producers of bismuth in the United States in 1938 were Anaconda Copper Mining Co., American Smelting & Refining Co., and United States Smelting, Refining & Mining Co. Bismuth also is imported and distributed in the United States by the Cerro de Pasco Copper Corporation from its properties in Peru.

## CONSUMPTION

Lack of a complete report on domestic sales and of official data on exports of bismuth prevents accurate appraisal of the annual domestic consumption. Heretofore pharmaceutical and medicinal manufacturers have used about 75 percent and low-melting-point and nonshrinking alloys the rest of the total consumption.

Bismuth subcarbonate, subnitrate, and subgallate are a few of the many bismuth compounds used in indigestion remedies, salves, ointments, powders, and other medicinal preparations. According to the Census of Manufactures the production of bismuth subcarbonate increased from 231,432 pounds valued at $364,265 in 1935 to 247,609 pounds valued at $313,426 in 1937—a 7-percent increase in quantity and a 20-percent decrease in average value. Bismuth subnitrate output declined from 269,193 pounds valued at $360,303 in 1935 to 262,867 pounds valued at $309,678 in 1937—2 percent in quantity and 12 percent in average value. Production of bismuth subgallate increased from 24,328 pounds valued at $38,686 in 1935 to 40,861 pounds valued at $55,270 in 1937—a 68-percent increase in quantity and a 15-percent decrease in average value. Approximately 285,000 pounds of bismuth were consumed in the preparation of these three compounds in 1937. In recent years the consumption of bismuth subsalicylate, bismuth potassium tartrate, and other bismuth compounds for the treatment of venereal diseases has increased. These compounds have largely replaced the mercury compounds formerly used. Bismuth compounds are also employed in preparing patients for X-ray examination, and powdered bismuth is used in X-ray-proof rubber goods.

In the metallurgical field bismuth is used in low-melting-point and nonshrinking alloys of wide practical applications. The metal is employed in almost all low-melting metallic alloys used for fusible plugs, safety devices, dental models, soft solders, and tempering baths for small tools and pieces. The Cerro de Pasco Copper Corporation markets its alloy trade-marked Cerromatrix chiefly for permanent mountings for punch and die parts; Cerrobase, for use mainly as a master pattern metal in the foundry industry; and Cerrobend (Woods metal), for use largely as a filler in bending tubes and moldings. A number of other low-temperature-melting alloys also are available. The principal alloying components used with bismuth are lead, tin, and cadmium. The recently developed free-cutting aluminum alloy, 11S, contains a small percentage of bismuth. Bismuth also is used in small quantities in iron castings, in special brake linings, in enameling and the manufacture of optical glass, in the manufacture of special instruments, and in plastics as bismuth subnitrate.

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## PRICES

On April 25, 1938, the New York quoted price for bismuth metal was advanced from $1 to $1.05 per pound for ton lots, which was maintained the remainder of the year, according to Engineering and Mining Journal Metal and Mineral Markets. At the same time London quotations increased from 4s. to 4s. 3d. per pound. Late in March 1939, the domestic price was advanced further to $1.10 and the London price to 4s. 6d. per pound. Manufacturers of some bismuth compounds and salts reduced quotations slightly in February, but advanced them substantially in August and October 1938. According to the Oil, Paint, and Drug Reporter, the minimum price for bismuth subcarbonate increased from $1.23 at the beginning of 1938 to $1.53 per pound (fiber drums) at the end of the year, subnitrate from $1.13 to $1.33, and subgallate from $1.33 to $1.58, but the price for subsalicylate remained constant at $2.35 per pound.

## FOREIGN TRADE

Bismuth metal imports in 1938 increased 37 percent over those in 1937. Of the 1938 imports, 91,728 pounds were from Peru and 570 from Canada. Imports of compounds, mixtures, and salts of bismuth decreased 36 percent in 1938. Of the bismuth compounds, etc., imported in 1938, 2,000 pounds were from Germany and 4 from the United Kingdom. In addition bismuth is imported as lead-bismuth alloy and in intermediate metallurgical products, statistical data for which are not available. Imports not valued chiefly for lead in 1938 totaled 779,155 pounds, including 626,830 pounds other than lead. This classification comprised imports from Belgium, the United Kingdom, Peru, and Germany. Of the 49,955 pounds from Peru, only 22,230 were lead; probably the balance was chiefly bismuth.

Official exports of bismuth metal are not recorded, but according to the Oil, Paint, and Drug Reporter shipments from Atlantic and Gulf ports totaled approximately 225,000 pounds in 1938 (about 900,000 in 1937). The bismuth was destined to ports in the United Kingdom and France. These figures doubtless include bismuth of foreign (shipments en route or from bonded warehouse) as well as of domestic origin.

*Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1934–38*

| Year | Bismuth | | Compounds, mixtures, and salts of bismuth | |
|---|---|---|---|---|
| | Pounds | Value | Pounds | Value |
| 1934 | 19,327 | $19,927 | 305 | $1,814 |
| 1935 | 102,051 | 78,061 | 871 | 4,798 |
| 1936 | 113,443 | 86,722 | 564 | 4,807 |
| 1937 | 67,225 | 54,007 | 3,145 | 9,117 |
| 1938 | 92,298 | 74,583 | 2,004 | 3,387 |

## WORLD PRODUCTION

World byproduct-bismuth output is estimated at approximately 3,000,000 pounds annually. Europe consumes about 1,500,000 pounds of metal annually, chiefly in pharmaceutical and medicinal prepara-

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tions. Most of the bismuth distributed in Europe is controlled by the world cartel. To base annual world consumption upon production and foreign trade of the metal is misleading, since the larger bismuth-refining plants seldom are operated until stocks of the metal become low, when metal is exported in large quantities. Consuming countries often import quantities adequate to supply demands for a long period. Likewise, the intermittent operation of bismuth-refining plants also makes it difficult to estimate production by individual years.

Official data on the total world production of bismuth are not available. The principal producing countries, in the probable order of importance, are as follows: United States, Peru, Mexico, Spain, Canada, Germany, and Japan. Virtually the entire world output is obtained as a byproduct in the treatment of lead, copper, silver, gold, tin, and tungsten ores. Most of the production probably is derived from the treatment of lead refinery slime. Byproduct production is greater than demand, and with the present price of bismuth it probably would be uneconomical to extract the metal from other than very high grade bismuth ores.

*North America.*—Mexico produced 409,612 pounds of bismuth in 1938 compared with 312,360 in 1937. Canadian bismuth output in 1938 totaled only 9,516 pounds compared with 5,711 in 1937 and 364,165 in 1936.

*South America.*—The bismuth metal output of Peru totaled 482,382 pounds in 1938 compared with 236,717 in 1937. Peruvian exports in 1938 included 454,657 pounds of refined bismuth in bars (196,132 in 1937) and 49,955 pounds of impure bismuth. The bismuth content of Bolivian exports totaled 42,316 pounds in 1938 compared with 67,942 pounds in 1937. Argentina also produces some bismuth ore.

*Europe.*—Spain doubtless will become an important factor in the world bismuth trade again, now that its civil war is ended. Of the 703,847 pounds of bismuth metal imported by the United Kingdom in 1937, 624,557 pounds were reported from the United States and 75,506 from Canada. Effective February 25, 1939, imports of both bismuth metal and alloy containing more than 50 percent bismuth and 15 percent lead by weight became duty-free. French metallic bismuth imports totaled 160 metric tons in 1938 compared with 40 in 1937. Bismuth is produced in the U. S. S. R. at the Chimkent (Central Russia) and Tetiukhe (Far East) lead works, and near Nerchinsk (Buriat-Mongol Republic) from tungsten-molybdenum ores.

*Africa, Asia, and Australia.*—The Union of South Africa produced 8,800 pounds of bismuth ore in 1938 (370 in 1937), chiefly from Cape Province. Bismuth carbonate occurs associated with tinstone and wolframite in Kigezi, Uganda, and in 1938, 930 pounds were exported.

Despite Sino-Japanese hostilities in South China in 1938, 52,120 pounds of bismuth ore were imported by devious routes into Hong Kong for export. Of the 51,454 pounds of bismuth ore exported from Hong Kong in 1938 (84,911 in 1937), 34,658 pounds went to the United Kingdom, 9,731 to Italy, 4,799 to Australia, and 2,266 to France.

Queensland, New South Wales, and Tasmania produced 20,160 pounds of bismuth ore in 1937.

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# MAGNESIUM

By Herbert A. Franke and M. E. Trought

## SUMMARY OUTLINE


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Increased interest in aircraft in the present national-defense program of the United States has again emphasized the growing importance of magnesium and other light alloys. Production (sales) of primary magnesium in the United States in 1938 was greater than ever before and exceeded that of 1937 by 6 percent. Consumption in industries other than aircraft and munitions probably dropped because of the downward trend in business activity in 1938. Statistics show a 4-percent decline in the use of magnesium structural and nonstructural products. The trend of total domestic consumption cannot be evaluated accurately owing to lack of data on stocks and exports. However, it appears that any decline in domestic consumption in 1938 was more than offset by sales to foreign consumers.

The 10-percent decline in the production of magnesium structural products probably was due to a pronounced drop in the manufacture of portable and high-speed equipment which was offset only partly by larger consumption in the aircraft industry. Considerable magnesium is used annually as a deoxidizer in the metallurgical industry and as a component of aluminum and other alloys, but the quantity so used probably decreased in 1938. The quoted nominal price of magnesium at New York remained unchanged at 30 cents per pound throughout 1938 but was reduced to 28 cents per pound in March 1939.

Outside of the United States production of magnesium increased at an even more rapid rate. World output totaled possibly 22,000 metric tons, an increase of 22 percent over that indicated for 1937. Germany continued as the outstanding producer, with an estimated output of 12,000 tons. Consumption also has advanced more rapidly in Germany, the United Kingdom, and other European countries than in the United States, particularly with regard to structural products used in airplanes, automobiles, and other transportation facilities. The rapid growth in the use of magnesium abroad is due to the armament and self-sufficiency programs of totalitarian and democratic countries as well as to development of new uses based upon its lightness and strength.



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## PRODUCTION

Sales of primary magnesium in the United States in 1938 totaled 2,410 short tons and thus established a new record. The Dow Chemical Co. of Midland, Mich., supplied the entire output. As heretofore the metal was produced by the electrolysis of magnesium chloride derived from undergound brine.

Because magnesium is classed as an essential material by the Army and Navy Munitions Board and because interest in national defense is high, the accompanying historical table is presented, which shows the quantity of domestic magnesium sold or used since 1915, when the industry was inaugurated. Prior to that time metallic magnesium was imported from Germany. The number of domestic producers dropped from five during the World War to two in 1920. In 1927 the American Magnesium Corporation ceased producing primary ingot, and since then the Dow Chemical Co. has been the sole producer and has supplied virtually all domestic requirements. Imports have been of little consequence since 1922. Exports of magnesium have been relatively large since 1933, but official data thereon are not available.

*Magnesium sold or used by producers and imported into the United States, 1915–38*

| Year | Sold or used by producers [1] | | Imports for consumption [2] | |
|---|---|---|---|---|
| | Pounds | Value | Pounds | Value |
| 1915 | 87,500 | $440,000 | (3) | (3) |
| 1916 | 75,400 | 311,462 | (3) | (3) |
| 1917 | 115,813 | 233,626 | (3) | (3) |
| 1918 | 284,118 | 615,217 | [3] 11,899 | [3] $16,259 |
| 1919 | 127,465 | 247,302 | 13,239 | 13,583 |
| 1920 | 123,800 | 233,200 | 29,275 | 25,055 |
| 1921 | 48,000 | 86,000 | 39,913 | 30,592 |
| 1922 | [4] 60,000 | [4] 89,000 | 182,939 | 54,448 |
| 1923 | [4] 125,000 | [4] 155,000 | 13,974 | 11,576 |
| 1924 | [4] 128,000 | [4] 150,000 | 8,738 | 6,561 |
| 1925 | 245,000 | [4] 274,400 | 8,326 | 7,070 |
| 1926 | 322,650 | 390,400 | 10,117 | 4,750 |
| 1927 | 366,400 | 441,700 | 7,131 | 8,402 |
| 1928 | 530,782 | 289,658 | 12,039 | 11,890 |
| 1929 | 908,351 | 512,313 | 3,490 | 6,539 |
| 1930 | 559,631 | 268,864 | 5,689 | 19,599 |
| 1931 | 580,463 | 199,633 | 2,454 | 2,580 |
| 1932 | 791,699 | 228,653 | 935 | 1,049 |
| 1933 | 1,434,893 | 377,181 | 575 | 734 |
| 1934 | 4,249,838 | (5) | 661 | 962 |
| 1935 | 4,241,218 | (5) | 884 | 1,292 |
| 1936 | 3,903,312 | (5) | 1,126 | 1,479 |
| 1937 | 4,539,980 | (5) | 1,321 | 1,727 |
| 1938 | 4,819,617 | (5) | 60 | 188 |

[1] 1915–27: Metallic magnesium (ingots, castings, alloys, ribbon, powder, rods, tubes, sheets, etc.); 1928–38: New ingot magnesium.
[2] Includes alloys and scrap (magnesium content).
[3] Not separately recorded prior to July 1918.
[4] Estimated.
[5] Bureau of Mines not at liberty to publish figures.

Figure 1 shows trends in magnesium production and prices since 1915.

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## CONSUMPTION

Lack of complete and official data on stocks and exports of magnesium prevents an accurate appraisal of annual domestic consumption. However, the substantial increase in exports indicated by unofficial data compared with the moderate increase in sales, the general recession in business conditions, and the falling off in production of manufactured magnesium products suggest that domestic consumption decreased in 1938.

Of outstanding interest in recent years is the trend in consumption of magnesium-rich alloys used as structural materials. Their use increased nearly 500 percent from 1932 to 1938, inclusive, despite a slight decrease in 1938. The 10-percent drop in consumption of structural products in 1938 compared with 1937 is ascribed to lower activity in the portable and high-speed equipment industries. The

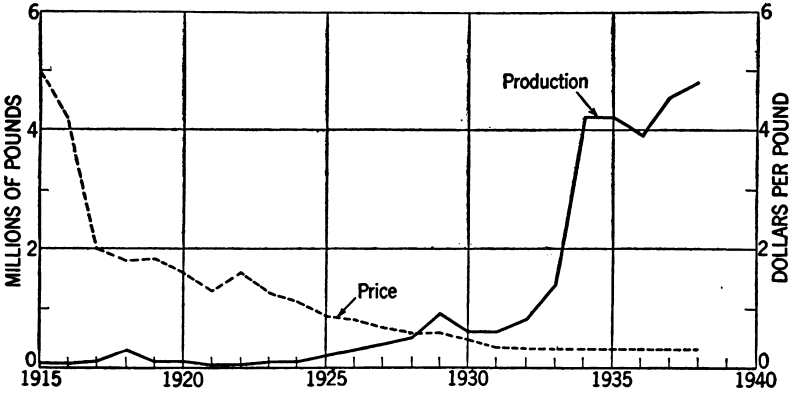


FIGURE 1.—Trends in quoted price and production of magnesium in the United States, 1915-38.

use of magnesium structural products in aircraft gained, and in 1939 and 1940 consumption in this industry is destined to be the greatest in history. The advance in consumption of nonstructural products in 1938 is attributable partly to the increased manufacture of pyrotechnics. The use of magnesium as a scavenger and deoxidizer in the metallurgical industry and as a component in aluminum and other alloys probably declined in 1938.

The following table shows the magnesium sold or used by domestic fabricators of magnesium metal and magnesium-rich alloys. Total manufactures of structural and nonstructural products decreased 4 percent from 1937 to 1938, and production of alloy ingot dropped 40 percent. Of the structural products, sales of sheet gained 6 percent, while sales of castings declined 10 percent, sales of structural shapes, rods, and tubing 8 percent, and those of forgings 81 percent. The 83-percent increase in the manufacture of total nonstructural products in 1938 is slightly exaggerated, as some products classified as "Wire and ribbon" were included under "Structural shapes, rods, and tubing" in 1937. Sales of ribbon decreased slightly.

The value of magnesium castings averaged $1.31 per pound in 1938 compared with $1.17 in 1937.

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*Magnesium products (other than ingot and stick magnesium) manufactured in the United States and sold or used by the companies manufacturing the products 1936–38*

[This table includes only the products made from magnesium or alloys containing high percentages of magnesium. It does not include the large quantity of metal used as a deoxidizer and in alloys with low magnesium content]

| Product | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Alloy ingot | 872,020 | (1) | 1,257,479 | (1) | 756,000 | (1) |
| Structural products: | | | | | | |
| Castings | 791,859 | $939,806 | 1,180,190 | [2]$1,375,884 | 1,067,310 | $1,392,882 |
| Sheet | 51,798 | 38,474 | 118,284 | 74,924 | 124,930 | 79,764 |
| Structural shapes, rods, and tubing | [3] 71,242 | [3] 82,532 | [3] 86,954 | [3] 94,250 | 80,206 | 49,972 |
| Forgings | 59,710 | 40,061 | 31,939 | 18,568 | 5,924 | 6,541 |
| Other structural | 1,031 | 2,469 | 1,024 | 1,797 | ---------- | ---------- |
| Total structural products | 975,640 | 1,103,342 | 1,418,391 | [3] 1,565,423 | 1,278,370 | 1,529,159 |
| Nonstructural products: | | | | | | |
| Wire and ribbon | [3] 875 | [3] 3,065 | [3] 811 | [3] 3,020 | 184,223 | 259,256 |
| Shavings | 37,917 | 18,838 | [4] 59,354 | [4] 26,042 | | |
| Powder | 27,594 | 49,732 | [4] 40,502 | [4] 75,110 | | |
| Total nonstructural products | 66,386 | 71,635 | 100,667 | 104,172 | 184,223 | 259,256 |
| Grand total (exclusive of alloy ingot) | 1,042,026 | 1,174,977 | 1,519,058 | [2] 1,669,595 | 1,462,593 | 1,788,415 |

[1] Bureau of Mines not at liberty to publish figures.
[2] Revised figures.
[3] Some products formerly classified as "Wire and ribbon" are included under "Structural shapes, rods, and tubing."
[4] Minor quantities of shavings included under "Powder"; separate figures not available.

## A list of magnesium fabricators in the United States in 1938 follows:

Louis Allis Co., 427 East Stewart Street, Milwaukee, Wis.
American Foundry Equipment Co., 400 South Byrkit Street, Mishawaka, Ind.
American Magnesium Corporation, Gulf Building, Pittsburgh, Pa. (Plant at 2210 Harvard Avenue, Cleveland, Ohio.)
Bohn Aluminum & Brass Corporation, 1400 Lafayette Building, Detroit, Mich. (Plant at 3516 Hart Avenue, Detroit, Mich.)
Detroit Pattern Plate Co., 6304 Epworth Boulevard, Detroit, Mich.
Delco Products Division of General Motors Corporation, 329 East First Street, Dayton, Ohio.
Doehler Die Casting Co., 386 Fourth Avenue, New York, N. Y. (Plant at Batavia, N. Y.)
Dow Chemical Co., Midland, Mich.
Eclipse Aviation, Division of Bendix Aviation Corporation, 1265 McBride Avenue, Little Falls, N. J. (Plant at West Paterson, N. J.)
Fremont Flask Co., Fremont, Ohio.
H. L. Harvill, Inc., 2344 East 38th Street, Los Angeles, Calif.
Hills-McCanna Co.,[1] 2353 Nelson Avenue, Chicago, Ill.
Hoover Co., North Canton, Ohio.
Madison-Kipp Corporation, Madison, Wis.
Magnesium Fabricators (Division of Bohn Aluminum & Brass Corporation), East Maumee Street, Adrian, Mich.
Magnesium Products, Inc.,[1] Los Angeles, Calif.
Pyle Pattern & Manufacturing Co., 1137 Sanford Street, Muskegon Heights, Mich.
Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland, Ohio.
Springfield Bronze & Aluminum Co., Springfield, Mass.
Wellman Bronze & Aluminum Co., 6017 Superior Avenue, Cleveland, Ohio.

[1] Commenced fabrication in 1939.

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Westinghouse Electric & Manufacturing Co., Cable Avenue, East Pittsburgh, Pa.
Wright Aeronautical Corporation, 132 Beckwith Avenue, Paterson, N. J.

New fabricators in 1938 were Fremont Flask Co., Madison-Kipp Corporation, and Magnesium Fabricators. The latter manufactures Magalloy X alloys (formerly trade-marked Bohnalite X). The alloys manufactured by the Dow Chemical Co. are trade-marked Dowmetal and those of the American Magnesium Corporation are known as AM Alloys.

The aircraft industry continued to increase its consumption of magnesium alloys in 1938, particularly sand and die castings. In airplane engines, magnesium castings were employed for crankcases, blower sections, accessory housings, pump bodies, rear sections, diffuser plates, and many miscellaneous parts. In the fuselage the metal was employed in landing and tail wheels, cockpit fittings, pedals, doorframes, levers, housings, and other secondary structural parts and interior appointments.[2] Sand castings weighing more than 300 pounds are used in some airplanes. The use of magnesium in aircraft is receiving more attention because the saving in weight means increased pay load, reduced power consumption, and improved performance. Experimental applications of sheet and shapes for cowling, fairings, and other secondary parts of planes are said to be successful. The aircraft defense program of the United States, the large foreign orders for airplanes, and the increased application of lighter structural parts are expected to increase magnesium consumption significantly in 1939 and 1940.

Magnesium structural products also are employed in portable tools, packaging machinery, vacuum cleaners, portable typewriters, optical instruments, small sewing machines, electric-motor fans, cameras, textile equipment, foundry flasks, and many other articles of portable and high-speed equipment. The textile field offers many opportunities for the use of magnesium products.

## PRICES

The nominal New York price for 99.8-percent ingot magnesium remained unchanged at 30 cents per pound, carload lots, throughout 1938, according to the Engineering and Mining Journal Metal and Mineral Markets. Quotations for less than carload lots, 100 pounds or more, were 32 cents per pound, with a premium of 5 cents a pound over ingot price for specified stick sizes (¼, ⅜, ½, 1, and 2 pounds each). Late in March 1939 the domestic price was reduced 2 cents, to 28 cents per pound for ingots in carload lots and to 30 cents per pound for 100-pound lots or more. The four-notched ingots commonly furnished are 4 by 4 by 28 inches and weigh approximately 17 pounds. Alloy ingot normally is quoted at 3 cents per pound more than pure magnesium ingot.

London quotations for magnesium in 1938 ranged from 1s. 5d. to 1s. 6d. per pound for ingot and stick and from 2s. 9d. to 5s. 6d. per pound for powder, according to grade and specification.

[2] Winston, A. W., Magnesium Alloys and Their Use in Aircraft: Paper presented before Aeronautical Sess., Western Metal Cong., Los Angeles, March 1938. Sutton, H., Light Alloys for Aircraft: Iron Age, vol. 143, No. 13, Mar. 30, 1939, pp. 30–92.

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## FOREIGN TRADE[3]

Although official export data on magnesium are not separately recorded, published information [4] indicates that a substantial quantity of the magnesium produced in the United States in 1938 went to Japan, the United Kingdom, and other European countries. Magnesium imported in 1938 comprised only 60 pounds of sheets, tubing, ribbons, etc., valued at $188. Imports in 1937 were 1,321 pounds of powder valued at $1,727. Of the 1938 imports, 48 pounds were from the United Kingdom and 12 from Germany.

## TECHNOLOGIC DEVELOPMENTS

Perhaps the greatest development during 1938 was the method devised to protect magnesium alloys from corrosion. The Dow Chemical Co. announced a caustic (sodium hydroxide) pressure treatment that produces a dense, adherent, abrasion- and corrosion-resistant film on the metal surface. The coating was designed primarily for the decorative treatment of small parts, such as die castings, as the film may be dyed a wide variety of colors as it is being formed. Its resistance to salt-water corrosion is said to be good. A process developed for the treatment of sand castings is claimed to afford protection superior to that of any other known method. It consists of a hydrofluoric acid dip followed by immersion in a boiling water solution of sodium dichromate. Another treatment for sand castings has been approved by the Navy Bureau of Aeronautics as an alternate for the PT–13 anodizing process. It includes surface cleaning, a dip in hydrofluoric acid followed by a boil in a solution of ammonium sulfate and sodium dichromate, and a seal by boiling in an aqueous solution of arsenous oxide. Paint is used as a final step in all methods of protecting the surface of magnesium alloys. A zinc chromate primer meeting Navy specification P–27 provides maximum protection and exhibits satisfactory adhesive qualities.[5] Navy specification and proprietary finishes based on glyceryl phthalate and phenol-formaldehyde resins give good results outdoors and in corrosive atmospheres, and lacquer type materials are satisfactory indoors. Research is being conducted on the reduction of iron and copper impurities in magnesium alloy to improve corrosion resistance. All these developments are expected to advance the use of magnesium alloy in saline, humid, and heavy industrial atmospheres.

The protective-treatment process for magnesium alloys invented by Sutton, Le Brocq, and Savage (British Patent 493,935) also is receiving wide recognition. The metal is treated by electrolysis in a solution of chromic acid and various other salts.

High-strength alloys for extrusions and forgings were studied intensively during 1938. A material has been produced experimentally, which has an ultimate strength exceeding 60,000 pounds per square inch and a yield strength of 50,000 pounds per square inch. As a result of development work in the forging field, magnesium alloys can be hot-pressed into more intricate shapes and larger pieces than

[3] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[4] Oil Paint and Drug Reporter. Exports from U. S. Ports: 1938.
[5] Gross, W. H., Cleaning and Painting Magnesium Alloys: Metal Cleaning and Finishing, vol. 10, No. 8, August 1938, pp. 554–556, 558, 562, 570.

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before. Research also has produced new casting and extrusion alloys with higher mechanical properties and corrosion resistance. A new die-casting alloy, Dowmetal R, is characterized by increased toughness and improved castability compared with Dowmetal K. It consists of 8.5 to 9.5 percent aluminum, 0.13 percent manganese, 0.4 to 0.8 percent zinc, and the remainder magnesium. Considerable research is being done in the United States and the United Kingdom [6] on the addition of silver to magnesium alloy. The results indicate a combination of high-yield strength with good ductility and no loss of corrosion resistance.

Low-grade magnesite ore can be concentrated by flotation methods developed by the Metallurgical Division of the Bureau of Mines.[7] The metal can be produced from concentrates either by the electrolysis of $MgCl_2$ obtained by chlorination or by reducing the calcined concentrates with carbon in an electric arc furnace at a temperature of about 2,000° C. In the latter process, originally developed in Austria, the metallic vapor formed is chilled suddenly as it leaves the furnace, and the condensate (consisting of metal powder, oxide, soot, and other impurities) is separated from the gaseous products. The metal is distilled from this product in a second furnace. The Bureau of Mines has made a substantial contribution to the solution of some of the unusual and difficult problems involved in this process.

The Northwest Magnesite Co. completed construction of a 5-ton (daily) experimental plant at Chewelah, Wash., in the fall of 1938 for the beneficiation of waste magnesite ores by flotation. This work suggests the possible future utilization of magnesite for the production of magnesium with cheap power generated at Bonneville and Grand Coulee.

The use of sea water and bittern as a source of magnesia for metal manufacture in the United States was recently suggested.[8]

The occurrence, production, and properties of magnesium are given in a recent German publication.[9] British magnesium foundry practice includes the addition of bentonite and iron oxide to the silica sand mold.[10] Surface rolling has been found effective in improving the fatigue strength of magnesium-alloy parts (e. g., aircraft propellers) which are subjective to erosion action.[11] Numerous United States patents have been granted recently in connection with magnesium production processes (Nos. 2,144,339, 2,134,969, 2,132,408, 2,123,990, 2,122,435, 2,147,645, 2,148,358, and 2,111,661), treatment methods, alloys, etc. British Patents 465,097 and 487,836 describe the thermal reduction of dolomite to magnesium using silicon or ferrosilicon and a small quantity of cryolite or other fluoride. Powdered magnesium can be used in the form of porous compacts for pyrotechnics.[12]

[6] Engineer (London), Magnesium Alloys: Applications and Future Development: Supplement, Feb. 24, 1939, pp. 8–11.

[7] Doerner, H. A., and Harris, Dwight L., Concentration of Low-Grade Magnesite Ores by Flotation: Washington State College, State Electrometallurigical Res. Lab., Bul. P. 1, Pullman, June 1938, 30 pp.
Magnesium from Magnesite Ores of the Pacific Northwest: Progress Reports—Metallurgical Division, No. 25: Bureau of Mines Rept. of Investigations 3419, Oct. 1938, pp. 32–37.

[8] Manning, Paul D. V., Magnesium Metal and Compounds: Chem. and Met. Eng., vol. 45, No. 9, September 1938, pp. 478–482.

[9] Gmelin's Handbuch der anorganischen Chemie: Pt. A, Secs. 1 and 2, 8th ed., 1937, pp. 156 and 222.

[10] Devereux, W. C., Magnesium Foundry Practice: Iron Age, vol. 142, No. 25, Dec. 22, 1938, pp. 25–27. (Originally published in Foundry Trade Jour., vol. 59, Sept. 22, 1938.)

[11] Sachs, G., Improving Aircraft Propellers by Surface Rolling: Metals and Alloys, vol. 10, No. 1, January 1939, pp. 19–23.

[12] Light Metals, Compacted Magnesium Flares: Vol. 1, No. 8, September 1938, p. 279.

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## WORLD PRODUCTION

Despite the continued increase in consumption of magnesium in recent years, official data on world production are still lacking owing to the fact that only estimates are available for all countries except the United States. It is estimated that the world produced 22,000 metric tons of magnesium in 1938 compared with 18,000 tons in 1937. The 1938 estimate by individual countries in tons is as follows: Greater Germany, 12,000; United Kingdom, 2,200; United States (sales), 2,186; Japan, 2,000; France, 1,800; Switzerland, 800; U. S. S. R., 600; and Italy, 400. The magnesium chloride electrolytic process continued to supply the greater part of the output. The principal raw materials used were potash final liquor, carnallite, magnesite, and brine. It is expected that a larger part of the output will be furnished by the thermal reduction process in 1939 when new plants in the United Kingdom, Japan, and Italy are scheduled to begin production. These new plants will use magnesite and dolomite as raw material. Since 1934 the number of producing countries has doubled, and the number of metal reduction plants has increased from 7 to 17. Before the end of 1939 probably more than five additional plants will be in operation.

*Canada.*—Reports state that the production of magnesium is contemplated in British Columbia and Quebec. The Consolidated Mining & Smelting Co. of Canada, Ltd., is conducting research on an electrothermic magnesium process.

*France.*—The production of magnesium is estimated at 1,800 metric tons in 1938 compared with about 1,500 tons in 1937. Although the three producing plants now use imported magnesite, dolomite could be utilized by making a few changes in the process. The reduction plant at Jarrie (Isère) was expanded considerably in 1938. During 1938 French imports of magnesium and its alloys totaled 159 tons (67 tons in 1937).

*Germany.*—Despite the set-back of the German magnesium industry in 1937 due to decreased exports, output in 1938 is estimated at 12,000 metric tons. At the end of 1937 about 6,000 tons of metal were in stock, but it was expected that domestic consumption would gain 5,000 to 6,000 tons in 1938 owing to measures taken to replace imported metals with magnesium. The automobile industry increased its consumption of magnesium alloys from 170 tons in 1936 to 1,400 in 1938, or 724 percent, by replacing aluminum and tin structural parts. This industry is expected to consume 2,500 tons of magnesium alloy annually in the near future. Magnesium alloys are employed in street cars and in place of copper-zinc alloys in the manufacture of engraving plates. The metal is also used for bus bars, switch installations in telephone apparatus, optical parts, measuring instruments, and similar equipment. The highly destructive German-made aerial bomb used in Spanish Civil War raids on Barcelona consisted of ammonium nitrate, powdered charcoal, and aluminum, enclosed in a magnesium-alloy shell. Germany has adequate magnesium-fabrication facilities, as only 40 percent of the foundry and 20 to 30 percent of the milling capacity was utilized in 1937.

The I. G. Farbenindustrie A. G., Bitterfeld, the leading producer, is supplementing potash end-liquor raw material with increasing quantities of Austrian magnesite. The metal is derived from the electrolysis of magnesium chloride at a temperature of 700° C. The Wintershall A. G., Heringen, on the Werra River uses carnallite as

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raw material and produces about 1,000 tons of metal annually by electrolysis. The former cost of producing magnesium ingot in Germany (1,835 RM. per metric ton) is believed to have been reduced in 1938. The Austrian Magnesite Co. and Steirische Magnesit A. G. are constructing a new 200-ton capacity (annual) magnesium plant at Radenthein in Kärnten, Austria. These companies own extensive and high-grade magnesite reserves in the Veitsch Valley, Steiermark, Austria, which have added materially to Germany's already adequate raw-material sources for magnesium.

Data upon magnesium exports in 1938 are not available, but they are believed to have been considerably less than in 1936, when approximately 3,400 tons were shipped to the United Kingdom, Czechoslovakia, and Italy.

*Italy.*—Magnesium is produced by the Società Anonima Magnesio Italiano Sulcis near St. Giovanni, Sardinia, by the electrolysis of magnesium chloride derived from domestic dolomite. Both Società Anonima per il Magnesio e le Leghe di Magnesio and Montecatini are constructing magnesium plants at Bolzano, which expect to begin operations in 1939. Apparently the former concern will reduce dolomite in an electric furnace in the presence of an iron catalyst and then condense the magnesium vapor by a special process.

*Japan.*—Although the production of magnesium in Japan has advanced greatly, published information indicates that it was necessary to import about 600 metric tons of metal from the United States alone in 1938 to supply demands. The Japanese output of magnesium in 1938 is estimated at 2,000 tons. Companies producing metal included the Nichiman Magnesium Co., Ltd., the Japan Magnesium Metal Co., Ltd., the Asahi Electro-Chemical Industry Co., Ltd., and the Japan Soda Co., Ltd. The first concern plans to increase its capacity from 900 to 1,500 tons of magnesium annually, which will make the total capacity of the four companies 4,220 tons. Both magnesite and sea water are used as raw materials, and both the thermal reduction and magnesium chloride electrolytic processes are employed. Metal production is planned by the Kwanto Electro-Chemical Co., Chosen Riken Metals Co., Japan Magnesium Co., Shinetsu Nitrogen Co., Manchurian Magnesium Manufacturing Co., Oriental Metal Industrial Co., and others. The Manchurian Magnesium Manufacturing Co. plans to build a plant in Yingkow and to use magnesite from Tashihchiao and magnesium chloride from salt works on the Gulf of Liaotung. The nationalization of the electrical industry in Japan is expected to result in the extension and consolidation of magnesium-producing companies and entrance into the field by power and aluminum companies.

*United Kingdom.*—British magnesium output in 1938 is estimated at 2,200 metric tons, although one source reports the output as 7,000 tons. The two British magnesium producers, Magnesium Elektron, Ltd., Clifton Junction,[13] and Magnesium Metal & Alloys, Ltd., Rainham, Essex, extended the productive capacity of their plants in 1938. Magnesium Elektron, Ltd., planned to utilize British dolomite instead of imported magnesite by the end of 1938.[14] The other concern is continuing development work on its thermal reduction process employing calcium carbide as the reducing agent. The new plant

[13] Light Metals, British Magnesium Production: Vol. 1, No. 6, July 1938, pp. 193–196.
[14] Ball, C. J. P., The Magnesium Industry in Great Britain: Light Metals, vol. 1, No. 3, April 1938, pp. 79–81.

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of the Magnesium Metal Corporation at Port Tennant, Swansea, England, was scheduled to begin production early in 1939. The Lancashire Metal Subliming Corporation, which is erecting a new magnesium works at St. Helens, Lancashire, reported the satisfactory operation of its pilot plant. Early in 1939 the International Alloys, Ltd., announced construction of another magnesium plant, near Cardiff, South Wales, to be operated by the Cardiff Corporation. As a result of the armament program there was a considerable expansion in magnesium fabrication facilities in the United Kingdom in 1938.

British imports of magnesium and its alloys in 1938 totaled 1,637 metric tons compared with 2,265 tons in 1937. Of the 1938 imports, 1,362 tons were from Germany, 208 from the United States, 46 from France, and 21 from Switzerland. The decline in imports indicates the effect of the growing domestic output of magnesium. Only 16 tons of metal were exported in 1938.

*Yugoslavia.*—A Yugoslav firm is experimenting with the production of magnesium metal from magnesite, large deposits of which occur near Maglaj, Uzice, and Vucitru and along the Vardar River.

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# ANTIMONY AND CADMIUM

By E. W. Pehrson and John B. Umhau[1]

## SUMMARY OUTLINE


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## ANTIMONY

The world antimony market in 1938 was influenced mainly by two factors—the slump in industrial activity in the United States and the curtailment of supplies from China. The net effect on prices was a substantial recession from the unusually high levels of 1937.

In the United States apparent consumption dropped 36 percent; but the decrease in actual consumption was less severe, as producers' and consumers' stocks were reduced during the year. Production of antimony contained in antimony ores fell 49 percent and supplied less than 6 percent of the total apparent consumption. Imports comprised only 59 percent of the quantity received in 1937; 84 percent of the antimony imported in 1938 was in the form of ore. Mexico continued to be the chief source of supply, but Bolivia increased in relative importance at the expense of Mexico. Imports of regulus totaled only 821 short tons and were the lowest in over 50 years.

Quotations for Chinese metal during 1938 trended downward despite the threatened shortage of supply, and published prices apparently were nominal for most of the year. Quotations for American metal remained more or less independent of those for Chinese metal, the average for the year being 12.35 cents per pound compared with 15.35 cents in 1937. Heretofore, American brands usually were priced 0.25 to 0.50 cent below Chinese brands, but in 1938 the differential averaged 2.24 cents. The quotation for Chinese 99-percent metal averaged 14.59 cents in 1938 and 15.30 cents in 1937.

Ore supply to the smelter at Laredo, Tex., was adequate throughout 1938, although the plant was shut down from April 25 to September 24. Finished products on hand were ample to meet customers' reduced requirements at all times. Antimony oxide was in greater demand than the metal during 1938. A new source of antimony

[1] Figures on imports and exports (except as otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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metal in the United States is the Los Angeles plant of the Menardi Metals Co., which began to produce antimony in 1938. The plant treats a mixed mercury-antimony concentrate imported from Mexico. The American Smelting & Refining Co. is said to be considering antimony production at its Perth Amboy plant, but no output was reported for 1938.

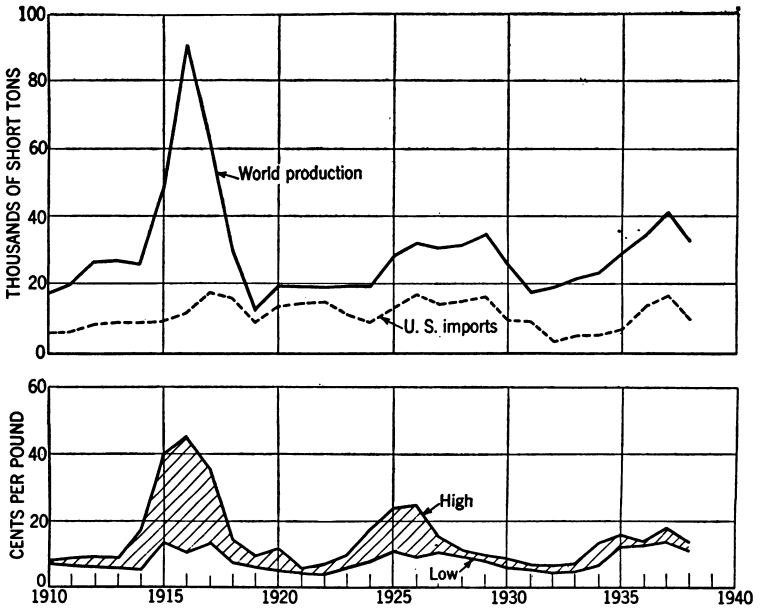


FIGURE 1.—Trends in world production, United States imports, and New York price of antimony, 1910-38.

World production was about 20 percent lower in 1938 than in 1937 (see fig. 1). Production in China (exports) declined 47 percent, whereas output in Bolivia, also measured by exports, increased 32 percent and was the highest on record. Bolivia thus attained first rank in antimony production in 1938. Mexico produced 24 percent less and fell from second to third place in world output.

*Salient statistics for antimony in the United States, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Production of antimony ore and concentrates.....short tons.. | 897 | 3,616 | 3,867 | 4,250 | 2,730 |
| Antimony contained.....do.... | 404 | 559 | 755 | 1,266 | 650 |
| Antimony content of antimonial lead produced from domestic and foreign ores.....short tons.. | 1,675 | 1,136 | 1,471 | 1,726 | 2,080 |
| Secondary antimony produced.....do.... | 7,550 | 9,600 | 9,900 | 12,340 | 8,500 |
| Imports for consumption: | | | | | |
| Antimony in ore.....do.... | 2,891 | 4,587 | 10,545 | 13,818 | 8,322 |
| Needle or liquated antimony.....do.... | 417 | 1,352 | 1,185 | 772 | 90 |
| Metal.....do.... | 1,765 | 1,248 | 1,171 | 1,043 | 821 |
| Oxide.....do.... | 269 | 594 | 1,201 | 1,118 | 414 |
| Exports of foreign antimony.....do.... | 402 | 318 | 392 | 437 | 711 |
| Primary antimony available for consumption.....do.... | 7,262 | 8,351 | 15,040 | 18,132 | 11,557 |
| Stocks of antimony in bonded warehouse at end of year.....short tons.. | 570 | 830 | 443 | 649 | 337 |
| Average price of antimony at New York: [1] | | | | | |
| Chinese.....cents per pound.. | 8.92 | 14.08 | 12.97 | 15.30 | 14.59 |
| American.....do.... | (2) | 13.62 | 12.25 | 15.35 | 12.35 |
| World production.....short tons.. | 24,900 | 32,700 | 38,000 | 41,100 | [3] 32,500 |

[1] According to American Metal Market. [2] Data not available. [3] Estimated.

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Throughout the year lines of communication between the antimony-producing centers and exporting points in China were harassed by Japanese activities in South China; and after the fall of Canton in October 1938 shipments from the mines virtually ceased, although exports from stocks at Hong Kong continued. Total exports for the year were the lowest since 1919, and for the first time in over 30 years China yielded first place in world output.

*National defense.*—Because antimony is an important industrial raw material and the United States depends largely on foreign sources of supply, this metal is one of 10 mineral commodities classified as strategic by the Army and Navy Munitions Board. Prior to 1931 the United States obtained a very large part of its antimony imports from China—in 1929, as much as 70 percent. Since this oversea supply could be cut off by a hostile fleet in time of war and since industry would be handicapped seriously if deprived of antimony, our situation at that time was highly unsatisfactory from a national defense viewpoint. In 1931, however, the strategic position was improved materially by establishment of an antimony smelter at Laredo, Tex., to treat Mexican antimony ores, and since that time Mexico has become the principal source of antimony for the United States. Meanwhile Bolivia also has increased its shipments of antimony ores to this country, so that at present the United States obtains a very large part of its antimony from sources in the Western Hemisphere. In 1938 over 85 percent of the total imports were purchased in Mexico and South America.

Notwithstanding this improved strategic position as to antimony there has been agitation for accumulation of a reserve stockpile in the United States, to be used if and when foreign supplies are cut off in a war emergency. The need for this precaution has been emphasized recently by events in Mexico and Bolivia which not only have increased the costs of producing antimony and thus retarded development of resources in those countries but also have threatened the free flow of ores to the United States. In this connection the anticipated passage of the Thomas bill (S. 572—76th Congress) by the Congress of the United States is significant. This bill provides $100,000,000 for the purchase of stockpiles of strategic commodities over a period of 4 years. In addition, the bill authorizes $500,000 to be expended annually for 4 years by the Bureau of Mines and the Geological Survey in investigating domestic resources of deficient strategic minerals. As of June 1, 1939, the bill was awaiting final approval by the Senate and House of Representatives.

*Domestic antimony resources.*—The development of a domestic antimony industry would be the most desirable method of overcoming our dependence on foreign sources of supply. Unfortunately, however, the known resources in the United States offer little hope of achieving that objective. This is evident from the accompanying historical record of production, consumption, and price of antimony in the United States from 1910 to 1938, which shows that under the stimulus of exceptionally high prices during the World War production in 1915 reached a peak of 4,900 tons, or about 35 percent of domestic requirements in that year. The following extracts from a report on strategic

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minerals recently prepared by the Bureau of Mines and the Geological Survey corroborate the foregoing conclusion:

*Sources.*—Several antimony-bearing minerals are found in many metalliferous deposits that are exploited largely for lead, copper, silver, and gold, and this antimony is finally recovered in the ordinary processes of smelting and treatment. Deposits that contain only stibnite (antimony sulfide), the principal source of antimony, are uncommon. This mineral is commonly found in tabular veins and even though these persist downward in the earth, experience in mining shows that the shoots of antimony sulfide are sporadic and largely confined to shallow surficial zones. For these reasons, the appraisals of reserves of antimony minerals are highly speculative unless the deposits are thoroughly explored.

*Production, imports, exports, apparent consumption, and prices of antimony in the United States, 1910–38*

| Year | Production [1] (short tons) | Imports [2] (short tons) | Exports [3] (short tons) | Apparent consumption (short tons) | Average price [4] (cents per pound) | Wholesale price index [5] (1913=100) | Antimony index price [6] (cents per pound) |
|---|---|---|---|---|---|---|---|
| 1910 | 1,598 | 5,890 | (7) | 7,488 | 7.27 | 100.9 | 7.21 |
| 1911 | 1,543 | 6,193 | (7) | 7,736 | 7.48 | 93.0 | 8.04 |
| 1912 | 1,224 | 8,505 | (7) | 9,729 | 7.63 | 99.0 | 7.71 |
| 1913 | 2,204 | 9,086 | (7) | 11,290 | 7.43 | 100.0 | 7.43 |
| 1914 | 2,530 | 9,035 | (7) | 11,565 | 8.53 | 97.6 | 8.74 |
| 1915 | 4,900 | 9,408 | (7) | 14,308 | 29.52 | 99.6 | 29.64 |
| 1916 | 2,547 | 11,999 | (7) | 14,546 | 25.33 | 122.5 | 20.68 |
| 1917 | 2,244 | 17,683 | (7) | 19,927 | 20.73 | 168.3 | 12.32 |
| 1918 | 1,557 | 16,052 | 50 | 17,559 | 12.55 | 188.1 | 6.67 |
| 1919 | [8] 1,943 | 9,061 | (7) | 11,004 | 8.16 | 198.6 | 4.11 |
| 1920 | [8] 2,033 | 13,763 | ---------- | 15,796 | 8.38 | 221.2 | 3.79 |
| 1921 | [8] 1,589 | 14,730 | ---------- | 16,319 | 4.92 | 139.8 | 3.52 |
| 1922 | 1,258 | 15,605 | ---------- | 16,863 | 5.42 | 138.5 | 3.91 |
| 1923 | 1,841 | 11,417 | ---------- | 13,288 | 7.81 | 144.1 | 5.42 |
| 1924 | 1,852 | 9,234 | 13 | 11,073 | 10.77 | 140.5 | 7.67 |
| 1925 | 1,972 | 13,446 | 19 | 15,399 | 17.50 | 148.3 | 11.80 |
| 1926 | 2,289 | 17,084 | 44 | 19,329 | 15.91 | 143.3 | 11.10 |
| 1927 | 1,996 | 14,208 | 28 | 16,176 | 12.34 | 136.7 | 9.03 |
| 1928 | 2,105 | 15,281 | 51 | 17,335 | 10.30 | 138.5 | 7.44 |
| 1929 | 2,311 | 16,273 | 57 | 18,527 | 8.94 | 136.5 | 6.55 |
| 1930 | 1,302 | 9,741 | 174 | 10,869 | 7.67 | 123.8 | 6.20 |
| 1931 | 768 | 9,737 | 107 | 10,398 | 6.72 | 104.6 | 6.42 |
| 1932 | 878 | 3,518 | 124 | 4,272 | 5.62 | 92.8 | 6.06 |
| 1933 | 870 | 5,421 | 270 | 6,021 | 6.51 | 94.4 | 6.90 |
| 1934 | 1,657 | 5,775 | 170 | 7,262 | 8.92 | 107.3 | 8.31 |
| 1935 | 1,110 | 7,492 | 251 | 8,351 | 13.62 | 114.6 | 11.88 |
| 1936 | 1,434 | 13,830 | 224 | 15,040 | 12.25 | 115.8 | 10.58 |
| 1937 | 1,636 | 16,720 | 224 | 18,132 | 15.35 | 123.6 | 12.42 |
| 1938 | 1,871 | 9,897 | 211 | 11,557 | 12.35 | 112.6 | 10.97 |

[1] Includes only antimony recovered in antimonial lead made from domestic antimony and lead ores. Does not include relatively small quantity recovered in other alloys and in compounds, for which data are not available. Antimony contained in domestic antimony ores produced in the United States, most of which was used in producing antimonial lead, was as follows: 1915, 2,100 tons mainly from California, Nevada, and Alaska; 1916, 1,770 tons mainly from Nevada, California, and Alaska; 1917, 390 tons mainly from Nevada; 1918, 50 tons; 1922, 4 tons; 1923, 10 tons; 1924, 33 tons; 1925, 33 tons; 1926, 43 tons; 1928, 42 tons; 1932, 419 tons of which 416 were from Idaho; 1933, 587 tons all from Idaho; 1934, 404 tons all from Idaho; 1935, 559 tons mainly from Idaho; 1936, 755 tons of which 729 were from Idaho; 1937, 1,266 tons of which 768 were from Idaho and the remainder principally from Alaska; and 1938, 650 tons of which 379 were from Idaho and the remainder principally from Alaska.

[2] Includes metal, antimony content of ores, and estimated content of needle or liquated antimony, antimony compounds, type metal, antimonial lead, and other alloys.

[3] Exports under drawback.

[4] 1910, Metal Statistics 1918, p. 365; 1911–38, Metal Statistics 1939, p. 493.

[5] Based on price indexes of U. S. Department of Labor.

[6] Average price divided by wholesale price index.

[7] Data not available.

[8] Includes foreign antimony used at domestic smelters, probably only a small part of the total.

For many years, China has been the source of 50 to 70 percent of the world's supply of antimony, but important sources exist in Mexico, Czechoslovakia, Bolivia, and France. China was the principal source of imports into the United States for many years, but since 1930 has given place to Mexico, which in recent years has contributed 60 percent of domestic imports, mostly in the form of ore. Numerous antimony deposits have been explored in the United States, but the

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principal sources are a few districts in Idaho, Nevada, California, and Alaska; most of these have been studied and reports on them are available.

*Production from domestic mines.*—The trend in production of metallic antimony in the United States has been determined by conditions at mines (such as the size, grade, and accessibility of the deposits), by the smelting facilities available, and by prevailing prices. As the smelting of antimony ores is not a complicated operation, small smelters have been installed at several mines, but sources of domestic ore large enough to justify construction of a large smelter have not yet been found. Since 1910, annual production has fluctuated widely, largely in response to changes in price. The largest smelter in the United States was erected at Laredo, Texas, to smelt ores from Mexico, and these have since formed the main contribution to domestic supply.

One district in Inyo County has been the principal source of ore in California, but this has been idle since the war, although other deposits have since been discovered and developed nearby. Several districts in Idaho, notably the Yellow Pine, in Valley County, have been noteworthy sources and seem to be capable of increased production at prices slightly higher than those recently prevailing. In Nevada, deposits containing notable amounts of stibnite have been explored at many places, but only a few have been able to ship ore in recent years. Apparently somewhat higher prices would be needed to insure continuous production. Other sources have been explored in Arkansas, Montana, Washington, and Alaska, but the production has been small and intermittent. At high prices, some deposits in the interior of Alaska could become important sources,

A review of the period from 1914 to 1919 shows an abrupt rise, then a steady decline of production in close response to rise and decline of prices. When this record is considered with operations at producing centers, it seems clear that most of the deposits were not physically exhausted but were unable to compete at prevailing prices.

Estimates of probable yield of domestic antimony follow:

*Potential production of antimony in the United States at assumed index prices of 10, 20, and 30 cents per pound, in short tons*

| Assumed index price per pound (cents) | Potential production | | |
|---|---|---|---|
| | First year | Second year | Third year |
| 10 | 1,000–1,500 | 1,000–1,500 | 1,000–1,500 |
| 20 | 2,500–3,500 | 3,000–5,000 | 4,000–6,000 |
| 30 | 5,000–7,500 | 6,000–10,000 | 8,000–12,000 |

*Technologic progress.*—There are no large low-grade disseminated deposits of antimony now known in the United States; therefore, it would appear that even though there was a decided improvement in the technology of the recovery of antimony it could not be applied commercially to the domestic resources.

## DOMESTIC PRODUCTION

*Mine output.*—Antimony produced in the United States is derived from both antimony ores and lead ores. Data on the quantity derived from lead ores are not available, because the Bureau of Mines cannot obtain full information on the output of various commodities made from byproduct antimonial drosses obtained in lead refining. These drosses are used in the manufacture of antimonial lead, other alloys, and chemical compounds such as oxides and sulfides. In 1938, antimonial lead containing 1,871 tons of antimony of domestic origin was produced at primary lead refineries, but this antimony was obtained from antimony ores as well as from lead ores in unknown proportions. Likewise, information on the amount of domestic antimony recovered in other alloys and compounds is not available.

The quantity of antimony contained in domestic antimony ores and concentrates produced in 1938 totaled only 650 tons—49 percent

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below that in 1937. The decline was due to reduced outputs at the Meadow Creek mine in the Yellow Pine district, Idaho, and the Stampede mine, Kantishna district, Alaska.

The Meadow Creek mine produced concentrates containing 379 tons of antimony in 1938 compared with 754 tons in 1937. The concentrates are largely ferruginous and in addition to antimony contain gold and silver. The product is shipped to the lead smelter at Midvale, Utah. On August 1, 1938, the Bradley Mining Co. took over the assets of the Yellow Pine Co., former operators of the mine. The Stampede mine operated by Morris P. Kirk & Son, Inc., produces a 50- to 55-percent concentrate which is shipped to alloy plants in the United States. Other producers for whom production or shipment of antimony was reported in 1938 included Meyers & Craig, Yreka district, Shoshone County, Idaho; Nevada Antimony Mines, Inc., from the Bloody Canyon mine, Pershing County, Nev.; and J. H. Caustin and Jack Flynn, Lovelock, Nev. The Menardi Metals Co., Los Angeles, Calif., purchased a small quantity of antimony ore from various unnamed producers in California. Statistics on the domestic output of antimony ores and concentrates and the antimony content thereof during the past 5 years are given in the salient statistics table. A large part of the antimony ore produced in the United States is charged to lead furnaces and recovered as antimonial lead.

*Smelter output.*—From 1935 to 1937, inclusive, the only active primary antimony smelter in the United States was that of the Texas Mining & Smelting Co. at Laredo, Tex. In 1938 the Menardi Metals Co. reported the production of antimony at its plant, Los Angeles, Calif. In May 1938 the press reported that the American Smelting & Refining Co. expected to start production of metallic antimony at its Perth Amboy plant, but no production of regulus was reported by the company for 1938.

Production of the Laredo plant from 1933 to 1937 was shown on page 648 of Minerals Yearbook, 1938. Data for 1938 are not available for publication.

The Los Angeles plant reported production of antimony metal from foreign and domestic ores in 1938 for the first time. The antimony is derived largely from livingstonite concentrates produced in Mexico. The principal product of the plant to date has been mercury.

Data on antimonial lead production at primary lead refineries are shown in the accompanying table. These represent only part of the total antimonial lead output, as large quantities are produced at plants that operate exclusively on scrap, and some hard lead is made by mixing antimony and soft lead.

*Antimonial lead produced at primary lead refineries, 1934–38, in short tons*

| Year | Production | Antimony content | | | | |
|---|---|---|---|---|---|---|
| | | From domestic ores | From foreign ores [1] | From scrap | Total | |
| | | | | | Quantity | Percent |
| 1934 | 16,607 | 1,657 | 18 | 588 | 2,263 | 13.6 |
| 1935 | 16,384 | 1,110 | 26 | 593 | 1,729 | 10.6 |
| 1936 | 23,230 | 1,434 | 37 | 691 | 2,162 | 9.3 |
| 1937 | 27,524 | 1,636 | 90 | 853 | 2,579 | 9.4 |
| 1938 | 24,123 | 1,871 | 209 | 720 | 2,809 | 11.6 |

[1] Includes lead ores, antimony ores, and metallic antimony.

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*Secondary production.*—The production of secondary antimony in the United States in 1938 totaled 8,500 tons, compared with 12,340 tons in 1937. Statistics for the past 5 years are shown in the salient statistics table. Additional information is given in the chapter in this volume on Secondary Metals—Nonferrous.

## DOMESTIC CONSUMPTION

Precise data on the consumption of primary antimony in the United States are not available owing to lack of information on dealer and consumer stocks and on the quantity of domestic antimony recovered in alloys other than antimonial lead and in compounds; however, an approximate idea of the trend of consumption can be obtained from the following table, which shows the annual supply available for consumption.

*Primary antimony available for consumption in the United States, 1934–38, in short tons* [1]

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Domestic antimony recovered in antimonial lead | 1,657 | 1,110 | 1,434 | 1,636 | 1,871 |
| Imports for consumption (antimony content): | | | | | |
| Antimony ore | 2,891 | 4,587 | 10,545 | 13,818 | 8,322 |
| Needle or liquated [2] | 292 | 946 | 830 | 540 | 63 |
| Compounds [3] | 241 | 502 | 975 | 909 | 336 |
| Type metal, etc | 586 | 209 | 309 | 410 | 355 |
| Regulus | 1,765 | 1,248 | 1,171 | 1,043 | 821 |
| Total available | 7,432 | 8,602 | 15,264 | 18,356 | 11,768 |
| Exports under draw-back | 170 | 251 | 224 | 224 | 211 |
| Available for consumption | 7,262 | 8,351 | 15,040 | 18,132 | 11,557 |

[1] Excludes domestic antimony recovered as miscellaneous alloys, oxides, and other compounds.
[2] Content estimated at 70 percent. [3] Content estimated at 80 percent.

Apparent consumption of primary antimony in 1938 declined 36 percent from 1937. This decrease, however, exaggerates the actual decline in the use of antimony in manufactured products, as consumers probably drew on stocks of raw materials accumulated during 1937 when a threatened shortage of Chinese antimony caused prices to rise to extraordinary levels. One of the principal uses of antimony is in the manufacture of storage batteries. According to the American Bureau of Metal Statistics 92,000 tons of antimonial lead were used for this purpose in 1938 compared with 107,060 tons in 1937. The antimony content of this material ranges from 4 to 12 percent, and while a large part of the total is supplied by battery scrap a substantial quantity of new antimony is required annually to "sweeten" the alloy.

Another extensive use of antimony is in the manufacture of babbitt metals employed in bearings. These are applied widely in automotive equipment, although cadmium-silver bearings have been used extensively in this field during the last few years.

The use of antimony in the manufacture of chemicals declined 37 percent in 1938 compared with 1937. In 1938, 4,393 tons of oxides and other compounds with an estimated antimony content of 3,539 tons were produced, whereas in 1937 (revised figures), 6,992 tons (5,667 content) were made. Figures for the 3 preceding years are as follows: 1936, 4,852 tons (3,940 content); 1935, 3,969 tons (3,227

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content); and 1934, 2,569 tons (2,101 content). Foreign ores are used largely in the manufacture of antimony chemicals. The principal compound made is the oxide, which is employed extensively as a pigment in sanitary enamelware. In recent years the addition of antimony oxide pigment to nitrocellulose enamels has been gaining.

## FOREIGN TRADE

The following tables show imports and exports of antimony and antimony products.

*Antimony imported for consumption in the United States, 1934–38*

| Year | Antimony ore | | | Needle or liquated antimony | | Antimony metal | | Antimony oxides and other compounds | |
|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Antimony content | | Short tons | Value | Short tons | Value | Short tons | Value |
| | | Short tons | Value | | | | | | |
| 1934 | 8,455 | 2,891 | $158,672 | 417 | $26,761 | 1,765 | $158,414 | 301 | $35,507 |
| 1935 | 14,205 | 4,587 | 544,608 | 1,352 | 165,446 | 1,248 | 250,771 | 628 | 94,783 |
| 1936 | 30,486 | 10,545 | 1,200,132 | 1,185 | 139,784 | 1,171 | 243,474 | 1,219 | 217,505 |
| 1937 | 42,453 | 13,818 | 1,775,011 | 772 | 101,963 | 1,043 | 228,485 | 1,136 | 249,152 |
| 1938 | 19,811 | 8,322 | 1,095,497 | 90 | 12,016 | 821 | 155,420 | 420 | 94,400 |

*Antimony imported for consumption in the United States, 1937–38, by countries*

| Country | Antimony ore | | | Antimony metal | |
|---|---|---|---|---|---|
| | Gross weight (short tons) | Antimony content | | Short tons | Value |
| | | Short tons | Value | | |
| 1937 | | | | | |
| Argentina [1] | 1,536 | 981 | $114,190 | | |
| Belgium | | | | 60 | $12,247 |
| Bolivia [1] | 1,678 | 1,047 | 169,710 | | |
| Canada | | | | (2) | 226 |
| Chile [1] | 2,892 | 1,707 | 282,770 | | |
| China | 251 | 128 | 17,260 | 466 | 88,224 |
| France | | | | 73 | 16,980 |
| Japan | 28 | 17 | 2,688 | | |
| Mexico | 34,736 | 9,110 | 1,047,625 | 415 | 100,453 |
| Peru | 1,267 | 792 | 136,088 | | |
| United Kingdom | 65 | 36 | 4,680 | 29 | 10,355 |
| | 42,453 | 13,818 | 1,775,011 | 1,043 | 228,485 |
| 1938 | | | | | |
| Argentina [1] | 1,101 | 715 | 69,931 | | |
| Belgium | | | | 25 | 5,009 |
| Bolivia [1] | 1,880 | 1,133 | 159,407 | | |
| Chile [1] | 1,201 | 776 | 127,156 | | |
| China | 70 | 43 | 4,571 | 661 | 118,199 |
| France | | | | 11 | 2,260 |
| Japan | | | | (2) | 24 |
| Mexico | 14,896 | 5,250 | 670,185 | 112 | 25,784 |
| Morocco | 2 | 1 | 162 | | |
| Peru | 661 | 404 | 64,085 | | |
| United Kingdom | | | | 11 | 3,799 |
| Yugoslavia | | | | 1 | 345 |
| | 19,811 | 8,322 | 1,095,497 | 821 | 155,420 |

[1] Imports credited to Argentina and Chile originate largely in Bolivia.
[2] Less than 1 ton.

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*Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1934–38, in short tons* [1]

| Year | Type metal and antimonial lead | Other alloys [2] | Total | Year | Type metal and antimonial lead | Other alloys [2] | Total |
|---|---|---|---|---|---|---|---|
| 1934 | 18 | 568 | 586 | 1937 | [3] 17 | 393 | 410 |
| 1935 | 89 | 120 | 209 | 1938 | [3] 59 | 296 | 355 |
| 1936 | [3] 56 | 253 | 309 | | | | |

[1] For details of gross weight and values see imports shown in Lead chapter of this volume.
[2] Chiefly in special antimony-lead alloys containing high percentage of antimony.
[3] Type metal only.

*Foreign antimony (regulus or metal) exported from the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 402 | $42,415 | 1937 | 437 | $86,991 |
| 1935 | 318 | 62,167 | 1938 | 711 | 96,836 |
| 1936 | 392 | 56,308 | | | |

In addition to the foreign exports reported above 211 tons of antimony were exported in 1938 in manufactures (chiefly storage batteries) under the draw-back provisions of the tariff law; 224 tons were so exported in 1937. Stocks of needle and liquated antimony and regulus on hand in bonded warehouses amounted to 337 tons at the end of 1938 compared with 649 tons on December 31, 1937.

## PRICES

The downward trend in prices evident at the close of 1937 continued in 1938. The average spot quotation for domestic metal (99.5 percent) in New York was 12.35 cents per pound in 1938 compared with 15.35 cents in 1937. Prices were stable at 13.75 cents throughout the first quarter of the year, but in the latter part of April the market began moving to lower levels as the volume of business continued small. The low for the year—10.75 cents—prevailed the latter part of July and most of August, but as business improved in late summer quotations advanced, reaching 12.25 cents on October 20. This price was maintained until early December, when a temporary slackening in demand forced prices down to 11.25 cents. As the year closed the market became firmer, and the quotation on December 31 stood at 11.75 cents.

Quotations for prompt Chinese metal (99 percent), as reported by the American Metal Market, were maintained at considerably higher levels than those for domestic antimony. The average for 1938 was 14.59 cents, duty paid, which was 2.24 cents above the average for American brands. In previous years the differential seldom had exceeded 0.50 cent per pound. However, one authority stated that it was doubtful if the actual sales price of Chinese metal in 1938 averaged more than 0.25 to 0.50 cent above that of American brands.[2]

On the London Metal Exchange quotations for English brands declined from £81–82 per long ton on January 1, 1938, to £70–71 on July 1, which price was maintained for the rest of the year. Foreign

[2] Henderson, H. P., Review of Antimony Market for 1938: Metals, vol. 9, No. 7, January 1939, pp. 13–15.

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regulus (in warehouse) was quoted at £63–66 on January 1, £46–48 on July 1, and £52–53 at the close of the year. In China the basis for quotations was changed several times during the year, so that a reliable picture of the trend of prices is not available. The market at Hong Kong was affected by the Sino-Japanese hostilities, and prices trended downward. At the beginning of the year the quotation was £58 per long ton but dropped to £40 in June, July, and August. During the last 4 months of the year the trend was upward, and at the end of the year the quotation was £43.[3]

*Average monthly quoted prices of antimony, prompt delivery at New York, 1934–38 in cents per pound* [1]

| Month | Chinese brands (duty paid) | | | | | American brands [2] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1934 | 1935 | 1936 | 1937 | 1938 | 1935 | 1936 | 1937 | 1938 |
| January | 7.21 | 14.36 | 12.96 | 14.14 | 15.56 | 14.11 | 12.74 | 14.14 | 13.75 |
| February | 7.17 | 14.50 | 13.05 | 14.69 | 15.74 | 14.25 | 12.99 | 14.55 | 13.75 |
| March | 7.54 | 14.50 | 13.42 | 16.92 | 15.75 | 14.25 | 13.07 | 16.37 | 13.75 |
| April | 7.92 | 14.30 | 13.50 | 16.79 | 15.65 | 14.04 | 12.67 | 16.02 | 13.65 |
| May | 8.49 | 13.91 | 13.50 | 14.79 | 14.46 | 12.73 | 12.41 | 14.79 | 12.46 |
| June | 7.89 | 12.75 | 13.20 | 14.70 | 13.94 | 12.50 | 11.72 | 14.70 | 11.73 |
| July | 8.02 | 12.75 | 13.00 | 14.79 | 14.00 | 12.50 | 11.24 | 14.81 | 11.02 |
| August | 8.52 | 12.93 | 12.57 | 15.53 | 14.00 | 12.50 | 11.12 | 15.34 | 10.88 |
| September | 8.76 | 13.54 | 12.50 | [3] | 14.00 | 13.22 | 11.76 | 16.59 | 11.32 |
| October | 9.39 | 15.62 | 12.50 | [3] | 14.00 | 15.34 | 12.07 | 16.92 | 12.06 |
| November | 12.38 | 15.30 | 12.50 | 15.91 | 14.00 | 14.19 | 12.21 | 15.87 | 12.25 |
| December | 13.81 | 14.54 | 12.93 | 14.69 | 14.00 | 13.84 | 12.95 | 14.12 | 11.56 |
| Average | 8.92 | 14.08 | 12.97 | 15.30 | 14.59 | 13.62 | 12.25 | 15.35 | 12.35 |

[1] Source: Metal Statistics, 1939, pp. 487, 495.
[2] No quotations published prior to 1935.
[3] No average due to lack of offerings during greater part of month.

Quotations for antimony ore on January 13, 1938, were reported as follows by Engineering and Mining Journal Metal and Mineral Markets: "Per (short-ton) unit of antimony contained, $1.50 @ $2.00, f. o. b. New York. London, per long-ton unit, 5s. 6d. @ 6s. 3d. for 60- to 65-percent sulfide ore." By August 4, New York quotations had declined to $1.20 @ $1.30 per short-ton unit for 50- to 55-percent ores, $1.35 @ $1.40 for 58- to 60-percent ores, and $1.60 @ $1.70 for 60- to 65-percent ores. London prices for 60- to 65-percent ores were 5s. 3d. @ 5s. 6d. per long-ton unit. At the close of the year the respective prices were $1.20 @ $1.25, $1.30 @ $1.40, $1.40 @ $1.60, and 6s. 3d. @ 6s. 6d.

## WORLD PRODUCTION

World production of antimony in 1938 is estimated at 29,500 metric tons, a decline of about 20 percent from the output in 1937. As measured by exports, production in China dropped 47 percent, and for the first time in many years that country ranked second in world output. Exports from Bolivia increased 32 percent and were the highest on record. Bolivia thus assumed first place in world antimony production, whereas Mexico, with a 24-percent decline in output, dropped from second to third place. Bolivia, China, and Mexico produced 29, 26, and 25 percent, respectively, of the world antimony supply in 1938; the United States produced less than 2 percent.

[3] Donovan, Howard, American consul, Hong Kong, March 27, 1939.

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*World production of antimony, 1934–38, by countries, in metric tons* [1]

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | | | |
| Canada | ---------- | ---------- | ---------- | [2] 18 | 34 |
| Honduras | ---------- | 5 | 1 | (3) | (3) |
| Mexico [4] | 2,455 | 4,204 | 6,719 | 9,788 | 7,391 |
| United States | 337 | 466 | 630 | 1,056 | 543 |
| South America: | | | | | |
| Argentina | ---------- | ---------- | ---------- | 31 | (3) |
| Bolivia [5] | 1,891 | 3,376 | 6,040 | 6,556 | 8,682 |
| Peru | 92 | 288 | 696 | 848 | 384 |
| Europe: | | | | | |
| Czechoslovakia | 928 | 1,944 | 829 | 997 | (3) |
| France | 232 | ---------- | ---------- | ---------- | (3) |
| Germany (Austria) | ---------- | ---------- | 100 | 200 | (3) |
| Greece | 73 | 29 | 159 | ---------- | (3) |
| Italy | 249 | 369 | 333 | 414 | (3) |
| Portugal | ---------- | ---------- | 20 | 49 | 131 |
| Yugoslavia | ---------- | 75 | 600 | 579 | 1,100 |
| Asia: | | | | | |
| Borneo, British | ---------- | 16 | 30 | 4 | (3) |
| China [6] | 15,548 | 17,700 | 16,348 | 14,702 | 7,797 |
| Chosen | ---------- | 2 | 14 | 8 | (3) |
| India, British | ---------- | 8 | 33 | 24 | (3) |
| Indochina | ---------- | 16 | 38 | 4 | (3) |
| Japan | 26 | 47 | 110 | (3) | (3) |
| Turkey (Asia Minor) | 27 | 103 | 457 | 536 | (3) |
| Africa: | | | | | |
| Algeria | 529 | 810 | 983 | 778 | 744 |
| Morocco: | | | | | |
| French | ---------- | 179 | 88 | 22 | 125 |
| Spanish | 247 | ---------- | [5] 12 | 158 | 93 |
| Southern Rhodesia | ---------- | ---------- | 68 | 64 | 63 |
| Union of South Africa | ---------- | 4 | 15 | ---------- | 18 |
| Oceania: | | | | | |
| Australia: | | | | | |
| New South Wales | 10 | 24 | 45 | 70 | (3) |
| Queensland | ---------- | ---------- | 4 | (7) | 7 |
| Victoria | ---------- | 5 | 94 | 145 | 195 |
| Western Australia | ---------- | ---------- | ---------- | [8] 245 | (3) |
| New Zealand | ---------- | ---------- | ---------- | ---------- | 1 |
| | 22,600 | 29,700 | 34,500 | 37,300 | [8] 29,500 |

[1] Approximate recoverable metal content of ore produced exclusive of antimonial lead ores. 80 percent of reported gross content is used as a basis of calculations for all countries except Bolivia, Mexico, Peru, and the United States, where 92 percent is used.
[2] Recoverable metal content of concentrates exported.
[3] Data not available.
[4] Includes antimony content of antimonial lead.
[5] Exports.
[6] Figures represent antimony content of regulus, crude antimony, and oxide exported.
[7] 434 kilos.
[8] Estimated.

## REVIEW BY COUNTRIES

*Argentina.*—According to American Vice Consul Robert E. Wilson, of Buenos Aires, the only antimony mine being worked in November 1938 was a property known as El Pabellon situated in the Cerro Granados, Department of Rincanada, Province of Jujuy. Approximately 50 metric tons of sulfide and oxide concentrates were produced in 1937, and during the first 8 months of 1938, 200 tons of oxide ore containing 60 percent antimony were produced. The mine has not been developed sufficiently to permit an estimate of its worth. The National Lead Co. produces about 15 tons of byproduct antimony each year at its lead smelter at Puerto Vilelas (Chaco).

*Canada.*—The new antimony refinery of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, B. C., was completed and put into operation during the last quarter of the year. The plant treats 10 short tons of silver-refinery byproducts daily, from which about 4 tons of antimony are recovered. No production for 1938

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was reported officially. Imports of antimony totaled 428 tons in 1938 and 588 tons in 1937.

*China.*—Rail movement of antimony from Changsha to Hong Kong via Canton, initiated the latter part of 1937 after the Yangtze River was closed to commerce, continued in 1938 despite frequent bombings from Japanese airplanes. However, in October Japanese activity in the vicinity of Canton closed the shipping route to Hong Kong, and subsequently shipments from Changsha were diverted to Haiphong, French Indochina, via Kweilin. In March 1939 Howard Donovan, American consul at Hong Kong, reported that antimony shipped via Haiphong would begin to arrive in Hong Kong within 2 or 3 months.

With the general reorganization of the Chinese Government on January 1, 1938, the Hankow Foreign Trade Office and the Antimony Administration at Changsha, both subsidiary to the Natural Resources Commission, were removed from the control of the Military Affairs Commission and placed under jurisdiction of the Ministry of Economy. The Hankow Foreign Trade Office continued to exercise strict control over the sale and exportation of antimony products, although no attempt was made to "squeeze" out private traders. Because of diversion of antimony trade from Hankow to Hong Kong, the price quotations of the Foreign Trade Office were made in Hong Kong currency beginning in May 1938, and early in June the office was moved to Hong Kong.

The usual excellent statistical reviews supplied by Vice Consul Robert M. Taylor from Hankow were received for the first 9 months of 1938, but he was unable to obtain any information after the Japanese occupation of Hankow in late October. A Reuter dispatch from Shanghai dated November 28, 1938, stated that the Japanese intended to press on to the antimony mines and to establish a Japanese antimony monopoly. However, as of May 1939 the mines were still under Chinese control. Unofficial data indicate a decline in production from 8,850 long tons for the first 9 months of 1937 to 7,565 for the same period in 1938. Shipments from Changsha to Hong Kong fell successively in the first three quarters of 1938, and all excess stocks were moved from Hunan Province to Hong Kong in anticipation of the Japanese invasion. On September 30 total stocks in the Hunan consular district were estimated at 837 tons, mostly at Changsha. Collective prices for regulus paid by the Antimony Administration at Changsha ranged from ch $560 to $580 per long ton (U. S. $140 to $145) during the first quarter of 1938. Similar data for the second and third quarters are not available, but from October 10 to 20 the published quotation was ch $436.

Exports for all of 1938 were reported officially as follows: Crude 535 long tons, oxide (etc.) 253 tons, and regulus 7,070 tons; for 1937 the figures were 2,220 tons, 602 tons, and 12,322 tons, respectively.

*Germany.*—The antimony mines at Neustift near Schleiming (Austria), idle in 1937 and 1938, were being reopened early in 1939, apparently with Government aid. Germany's recent conquests have not improved her antimony position, as Austria depended largely on imported metal, and Czechoslovakia's production only equaled local requirements. Germany imported 3,643 metric tons of antimony metal in 1938 and 2,672 tons in 1937.

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*Japan.*—Little information is available on the progress made in the various projects to increase Japan's antimony production mentioned in Minerals Yearbook, 1938. Presumably local deposits have not equaled expectations, as a trade report in August 1938 stated that a Japanese concern had arranged to import 200 metric tons of antimony ore per month from Bolivia.

*Mexico.*—A unique source of antimony is the deposit of livingstonite, a rare mercury-antimony sulfide ($HgS.2Sb_2S_3$), in the Huitzuco district, Guerrero. The crude ore is treated by flotation, and the concentrate is shipped to the plant of the Menardi Metals Co., Los Angeles, Calif., where both refined mercury and antimony are produced.[4] In 1937, 30,184 short tons of ore with an average content of 1.25 percent antimony and 0.315 percent mercury were produced, and from January 1 to November 30, 1938, 46,822 tons, averaging 0.96 percent antimony and 0.24 percent mercury, were treated. In the latter part of 1938, 3 to 4 tons of concentrate containing 25 to 30 percent antimony and 7 to 11 percent mercury were being produced daily.

In August 1938 a 12-percent export tax was imposed on virtually all products shipped from Mexico. The tax presumably was designed to give the Government the benefits accruing to exporters from depreciation in the foreign exchange value of the peso. It is levied on the basis of an official valuation of commodities established monthly; in the case of metals and ores, one value apparently applies to all products regardless of the form in which they are exported and notwithstanding the fact that low-grade ores are less valuable per unit of metal than high-grade products. The tax thus has tended to be unduly burdensome on the producers of low-grade antimony ores, shipments of which are said to have been curtailed sharply in 1938.

*Yugoslavia.*—The Podrinje Consolidated Mines, Ltd., completed its modernized smelter, which now has an annual capacity of 1,800 tons of antimony. Another smelter is reported to have been completed at the Zajaca mine near Loznica, owned by Montania A. G.

## CADMIUM

In 1938 the cadmium industry experienced one of the worst years in its history. In contrast to the extraordinary demand and ascending prices in the 3 previous years, consumption fell abruptly and prices collapsed. At the close of the year the New York quotation for commercial sticks was 60 cents per pound compared with official quotations of $1.25 and reported sales of prompt metal at $2.00 during the acute shortage in the summer of 1937. According to trade reports the domestic price situation was aggravated further by the 50-percent reduction in the import duty (from 15 to 7.5 cents per pound), effective January 1, 1939, negotiated in the trade agreement with Canada signed November 17, 1938.

The statistical record indicates a 34-percent decline in apparent consumption of cadmium in all forms, but sales of metal by domestic producers to domestic consumers dropped 54 percent. Imports

[4] Vaupell, C. W., Mercury Deposits of Huitzuco, Guerrero, Mexico: Mining Technology, A. I. M. E., vol. 1, No. 5, September 1937, 14 pp.
Segura, David, Metallurgy of the Huitzuco Mercury Ores: Metals Technology, A. I. M. E., vol. 5, No. 2, February 1938, 7 pp.
Menardi, H. B., Reduction of Livingstonite Concentrate: Metals Technology, A. I. M. E., vol. 6, No. 2, February 1939, 8 pp.



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declined 97 percent, and for the first time large exports were reported to the Bureau of Mines. The decline in consumption may be ascribed in part to the 48-percent reduction in automobile production, one of the principal outlets for cadmium as a constituent of bearing metals. According to a well-informed authority, there was a 50-percent decline in this use of cadmium during 1938. Undoubtedly substitutes for cadmium plating, developed during the period of high prices, made additional inroads on the cadmium market in 1938, and consumption of cadmium compounds was much lower.

Despite the sharp reduction in demand, production of cadmium held up remarkably well in 1938. The total output decreased only 13 percent, production of metal 6 percent, and that of compounds (cadmium content) 48 percent. There were two new producers of metallic cadmium in 1938. Figures on production and sales for 1937 and 1938 reveal that producers' stocks of metal at the end of 1938 totaled at least 1,750,000 pounds.

World production, estimated at 4,200 metric tons in 1938, was virtually unchanged from 1937. Declines in the United States, Australia, Canada, and South-West Africa were offset by gains in Belgium, Germany, Poland, and probably Italy. London prices declined steadily throughout the year.

*Cadmium produced, sold by producers, imported, and consumed in the United States, 1934–38, in pounds*

| Year | Produced | | | Metallic cadmium sold by producers | Metallic cadmium imported | Apparent consumption |
|---|---|---|---|---|---|---|
| | Metallic cadmium | Cadmium compounds (estimated content) | Total cadmium | | | |
| 1934 | 2,777,384 | 566,700 | 3,344,000 | 2,472,971 | 125,955 | 3,470,000 |
| 1935 | 3,477,091 | 507,400 | 3,984,000 | 4,023,900 | 185,387 | 4,169,000 |
| 1936 | 3,633,495 | 626,800 | 4,260,000 | 3,626,669 | 576,139 | 4,836,000 |
| 1937 | 3,995,739 | 828,000 | 4,824,000 | 3,801,321 | 828,535 | 5,652,500 |
| 1938 | 3,753,323 | 431,000 | 4,184,000 | [1] 2,191,035 | 22,582 | 3,748,000 |

[1] Of this quantity 458,283 pounds were exported.

## DOMESTIC PRODUCTION

The cadmium production shown in the foregoing table includes metal derived from domestic and foreign raw materials refined in the United States. Data are not available on the quantity produced from each source, but foreign metal apparently represents a substantial part of the total. In 1938 Mexico reported shipments of crude materials to the United States containing 838 tons of cadmium compared with approximately 683 tons in 1937.

Cadmium is derived chiefly as a byproduct from zinc ores, and its production depends to some extent on the rate of zinc output. In recent years, however, stocks of cadmium-bearing flue dusts and similar products accumulated over a period of several years have made possible an increase in cadmium production that is relatively more rapid. By 1937 much of this material had been used, and in 1937 and 1938 production was limited to some extent to that derived from current zinc operations. A more severe decline in output in 1938 was avoided by new plants coming into production and the increased imports of

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crude materials from Mexico. New producers of metallic cadmium in 1938 included the Henryetta (Okla.) smelter of the Eagle-Picher Mining & Smelting Co. and the Josephtown (Pa.) plant of the St. Joseph Lead Co. A cadmium dust-recovery plant was completed late in 1937 at the Fort Smith (Ark.) zinc smelter of the Athletic Mining & Smelting Co. The dust is shipped to the East St. Louis plant of the American Zinc Co. of Illinois for conversion. There were no new producers of cadmium compounds in 1938.

A list of producers of both metal and compounds in 1936 was published on page 742 of Minerals Yearbook, 1937. To this should be added the American Steel & Wire Co., Donora, Pa., a new producer of refined cadmium in 1937, and the two new producers in 1938 mentioned above.

A small but increasing quantity of secondary cadmium is recovered from scrap resulting from the manufacture of automobile bearings. This is not included in the statement of production, as it would represent duplication of metal previously reported.

Since the zinc concentrates of the Tri-State region constitute the largest potential source of cadmium in the United States, the following information on the cadmium content of ores from this district is of interest. (The data have been obtained through the courtesy of the Tri-State Zinc and Lead Ore Producers Association.) One series of tests on ores from the various camps in the district indicated an average cadmium content of 0.40 percent for coarse concentrates (30 samples), 0.31 percent for sludge (9 samples), and 0.36 percent for flotation concentrates (48 samples). The content did not vary appreciably between the various parts of the district. An analysis by L. T. Merrill, of the Picher Assay Office, of a sample from 7 tons of sample rejects collected in 1930 gave the following results:

| | *Percent* | | *Percent* |
|---|---|---|---|
| Zinc | 58. 000 | Lime | 0. 670 |
| Iron | 1. 700 | Magnesia | . 508 |
| Lead | 1. 520 | Silica | 4. 990 |
| Copper | . 060 | Carbon dioxide | 1. 081 |
| Cadmium | . 387 | | |
| Sulfur | 30. 837 | | 99. 753 |

In 1937 the district produced 446,890 tons of zinc concentrates which, at an average cadmium content of 0.37 percent, contained approximately 3,300,000 pounds of cadmium. Probably less than one-fourth of this amount actually was recovered in 1937, indicating that a substantial increase in production from this source is possible should market conditions warrant the necessary investment in plant and equipment.

## DOMESTIC CONSUMPTION

The statistical trends in consumption during 1938 have been discussed in the summary at the beginning of the cadmium section of this chapter.

One of the principal uses of cadmium is in bearing metals for high-speed internal-combustion engines. Consumption for this purpose has been estimated at approximately 1,000,000 pounds in 1937 and 500,000 pounds in 1938. According to an authority in the trade, during 1938 there were additional users of cadmium bearings, and all former consumers continued to employ them. As stated in Minerals

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Yearbook, 1938, some difficulty has been experienced from corrosion of cadmium alloys by lubricants, and several methods of overcoming it have been developed. J. G. Ryan (U. S. Patent 2,116,851, May 10, 1938) states that the addition of 0.1 to 5.0 percent antimony to cadmium-silver alloys improves their resistance to corrosion.

Several articles relating to the uses of cadmium were published recently. Alloys were discussed by Wilson and Wick[5] and Monselise.[6] Erskine [7] has described methods for coloring cadmium electrodeposits, and Rinker [8] and others [9] discussed electroplating technique. Two United States patents (Nos. 2,115,080 and 2,134,055) were issued during 1938 on processes for making cadmium red pigments.

## FOREIGN TRADE

Official statistics record separately only the imports of metallic cadmium. There is a limited import and export trade in cadmium compounds, and some metal is known to have been exported before 1938, but the quantities involved are believed to be relatively unimportant. In 1938, however, there was considerable exportation of cadmium metal. Reports to the Bureau of Mines indicate that four companies shipped 458,283 pounds abroad in 1938. Exports of cadmium with benefit of draw-back, mostly in lithopone, totaled 36,081 pounds in 1938 and 23,508 in 1937. Imports of metallic cadmium decreased very substantially in 1938, being only 22,582 pounds compared with 828,535 in 1937. Of the 1938 total, Belgium supplied 20,067 pounds; Italy, 2,240; Poland, 220; and Germany, 55. Of the quantity received in 1937, Canada supplied 270,620 pounds; Belgium, 250,878; United Kingdom, 139,405; Norway, 76,940; Germany, 34,562; Poland, 27,557; Australia, 22,400; France, 3,968; and Netherlands, 2,205. The average value of the cadmium imported in 1938, as reported by the Customs Bureau, was $1.35 per pound compared with $1.30 in 1937 and $0.71 in 1936. The United States also imports crude materials containing cadmium for refining. Shipments of this type of material from Mexico to the United States during 1938 contained 838 tons of cadmium compared with 683 tons in 1937.

## PRICES

According to Engineering and Mining Journal Metal and Mineral Markets, the average price of cadmium in 1938 was 98.0 cents per pound compared with $1.223 in 1937, 97.8 cents in 1936, 70.5 cents in 1935, and 55 cents from 1932 to 1934. In 1929 the price ranged from 80 to 95 cents per pound. Incomplete data obtained from producers by the Bureau of Mines indicate that the average value realized on sales of metallic cadmium in 1938 was 75 cents per pound compared with $1.14 in 1937, 80 cents in 1936, and 50 cents in 1935.

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[5] Wilson, Curtis L., and Wick, Oswald J., Cadmium-Indium Alloy System: Ind. and Eng. Chem., vol. 29, October 1937, pp. 1164-1166.
[6] Monselise, G. G., Cadmium Alloys and Their Applications: Chim. et ind., vol. 20, 1938, pp. 201-203.
[7] Erskine, William J., Coloring of Cadmium: Met. Ind. (New York), vol. 37, No. 3, March 1939, p. 123.
[8] Rinker, E. C., Cadmium on Steel: Steel, vol. 104, No. 5, January 30, 1939, pp. 44-46.
[9] Camel, Leroy, Method and Composition for Cadmium Plating: U. S. Patent 2,143,760, January 10, 1939.
Cadmium vs. Zinc Plating: Met. Ind. (New York), vol. 36, No. 11, p. 510, November 1938.

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At the beginning of 1938 patented shapes for platers were quoted at $1.35 per pound, New York, and producers' minimum price for quantity business in commercial sticks was $1.00. With production maintained at fairly high levels and consumption waning, stocks began to accumulate and prices weakened. On April 1 both quotations were reduced 15 cents per pound, and subsequent cuts in August and September brought prices down to 65 cents for commercial sticks and 95 cents for platers' shapes. On November 24 a further reduction to 60 and 85 cents, respectively, was announced. This was attributed by the trade to the Canadian Trade Agreement signed on November 17, under which the United States import duty on cadmium was reduced from 15 to 7.5 cents per pound, effective January 1, 1939. No change in quotations was made during the remainder of the year.

At the close of the year, Engineering and Mining Journal Metal and Mineral Markets (December 29, 1938, p. 3) issued the following statement regarding publication of monthly average cadmium prices during 1939:

> In addition to the monthly average price of cadmium that we have been publishing for the last 9 years, a monthly average will be established in 1939, beginning with January, on the price quoted by producers on ordinary commercial shapes, quantity business.
>
> The old average, accepted in the industry as representing the average of the producers' and platers' quotations, will be continued because several contracts have been made on that basis.
>
> Confusion over cadmium quotations has obtained for a number of years, largely because of the numerous changes that have occurred in reference to new outlets for the metal. Platers market a fairly large poundage at a premium over the producers' quotations, delivering patented shapes and servicing the process used in plating as well. Not so many years ago the platers virtually dominated the market because of the large proportion of the metal that was consumed in the plating industry. Since 1936, however, the automotive industry has found extensive use for cadmium in the production of bearings for internal-combustion motors. The price situation appears to be clearing, and we find that a need now exists for a straight producer's quotation.

According to Quin's Metal Handbook, London quotations (listed as nominal) declined steadily throughout 1938 from 5s. 2.5 d. ($1.30) per pound on January 1 to 2s. 1d. (48.0 cents) on December 31. During the first 5 months of 1938 London prices exceeded or approximately equaled New York quotations, but for the remaining months quotations in London were approximately 7 to 12 cents under the domestic market.

## WORLD PRODUCTION

Statistics from countries that produced 86 percent of the total output in 1937 indicate that world production of cadmium in 1938 was virtually the same as in 1937. The United States contributed 45 percent of the estimated total for 1938, some of which was from imported crude materials. Declines were noted in the outputs of Australia, Canada, and South-West Africa, as well as in the United States, whereas Belgium, Germany, and Poland achieved substantial increases. Italy probably produced more cadmium in 1938 than in 1937, but statistics thereon are not available at this time.

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*World production of cadmium, 1934–38, by countries, in kilograms*

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia (Tasmania) | 172,588 | 222,108 | 251,826 | 210,608 | 185,121 |
| Belgium | 160,076 | 150,999 | 203,997 | 271,000 | [1] 479,700 |
| Canada | 133,179 | 263,323 | 356,484 | 338,018 | 317,122 |
| France | 66,000 | 121,000 | 84,000 | 99,000 | [2] |
| Germany | 14,000 | 167,000 | 302,000 | 355,000 | 432,000 |
| Italy | 8,345 | 16,360 | 54,630 | 90,850 | [2] |
| Japan | [3] 1,800 | 3,236 | 23,563 | [2] | [2] |
| Mexico | [4] | [4] | [4] | [4] | [4] |
| Norway | 137,324 | 118,335 | 101,876 | 154,192 | [2] |
| Poland | 143,557 | 120,700 | 140,900 | 124,461 | 182,591 |
| South-West Africa | 63,500 | 145,150 | 98,900 | 138,345 | 116,000 |
| U. S. S. R. | 2,585 | 12,000 | 50,000 | 50,000 | [2] |
| United Kingdom | [1] 6,073 | [1] 5,091 | 22,160 | 124,142 | [2] |
| United States: | | | | | |
| Cadmium compounds [5] | 257,049 | 230,152 | 284,310 | 375,573 | 195,000 |
| Metallic cadmium | 1,259,794 | 1,577,174 | 1,648,117 | 1,812,427 | 1,702,470 |
| | 2,450,000 | 3,150,000 | 3,600,000 | [3] 4,200,000 | [3] 4,200,000 |

[1] Exports.
[2] Data not available. Estimate included in total.
[3] Estimated production.
[4] The Mexican Government reports the total cadmium content of material produced in Mexico as follows: 1934, 384,714 kilos; 1935, 597,527 kilos; 1936, 535,017 kilos; 1937, 619,792 kilos; and 1938, 762,398 kilos. This material is exported for treatment elsewhere; therefore, to avoid duplication of figures, the data are not included in this table.
[5] Estimated cadmium content.

## REVIEW BY COUNTRIES

*Australia.*—The Electrolytic Zinc Co. of Australia, Ltd., recovered 35 long tons of cadmium from Tasmanian zinc ores and 147 tons from other ores, chiefly from Broken Hill. In 1937, 45 tons were derived from Tasmanian ores and 162 tons from other ores. Cadmium by-products are recovered at the Port Pirie lead smelter, South Australia. Forty-six tons of precipitates were produced in 1937 and presumably shipped to Risdon for refining. Data are not available on the cadmium content of these products and the quantity produced in 1938.

*Canada.*—Cadmium is obtained as a byproduct at the electrolytic zinc plants at Trail, B. C., and Flin Flon, Manitoba. Production at Trail increased from 218 short tons in 1937 to 255 in 1938, whereas that at Flin Flon declined from 154 to 94 tons owing to the fact that stocks of precipitates accumulated before the cadmium plant was opened in 1936 were exhausted in June 1938.

*Germany.*—The increase in output in 1938 reflects the larger production of zinc in that year. Cadmium is recovered at the Magdeburg electrolytic zinc plant and at the Oker vertical-retort smelter. The Magdeburg plant can produce 150 to 180 metric tons of cadmium annually. According to American Consul Sydney B. Redecker, Frankfort on the Main, Germany treats cadmium-bearing flue dusts from South-West Africa, imports of which have been as follows: 64 tons in 1934, 145 in 1935, 99 in 1936, and 133 in 1937. Figures for 1938 are not available.

Despite the increased output in 1938 there was a scarcity of cadmium. Imports increased considerably, but data thereon are not recorded separately. Norway, Poland, Italy, and the United Kingdom supplied most of the metal imported in 1938.

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*Italy.*—The new 100-ton-per-year plant at Porto Marghera was put into operation in June 1938. Italy's production now exceeds domestic requirements.

*Japan.*—The Metal Bulletin, London (Jan. 10, 1939), reports that Japanese demand for cadmium is supplied largely by production from the Miike works of Mitsui Mining Co., the Hosokura and Naoshima works of the Mitsubishi Mining Co., and the Tsu plant of Nippon Soda Co. These three companies control the trade in cadmium through a cartel.

*Norway.*—Cadmium is recovered as a byproduct from the electrolytic zinc plant of Det Norske Zinkkompani A. S. of Eitrheim, the only producer of zinc and cadmium in Norway.

*South-West Africa.*—Cadmium-bearing flue dusts containing about 30 percent cadmium are produced as a smelter byproduct at the Tsumeb copper-lead mine. In 1938 exports amounted to 672 metric tons compared with 436 tons in 1937. Shipments in 1938 were consigned to Antwerp, Belgium.

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# PLATINUM AND ALLIED METALS

By H. W. Davis

## SUMMARY OUTLINE


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The outstanding statistical feature of the platinum industry in 1938 probably was the phenomenal increase in production in Alaska. Although the United States is by far the largest consumer of platinum metals in the world, prior to 1935 only small quantities were produced annually from domestic sources. For example, the average annual production was only about 8,300 ounces from 1925 to 1934, inclusive. Since then, however, domestic output (chiefly of placer platinum in Alaska) has advanced progressively from 11,552 ounces in 1935 to 49,380 ounces in 1938.

*Salient statistics of platinum and allied metals in the United States, 1937–38, in troy ounces*

| | 1937 | 1938 | | 1937 | 1938 |
|---|---|---|---|---|---|
| Production: | | | Stocks in hands of refiners, Dec. 31: | | |
| Crude platinum from placers | 10,803 | [1] 42,043 | Platinum | 60,236 | 71,058 |
| New metals: | | | Palladium | 21,942 | 30,071 |
| Platinum | [2] 36,174 | [2] 30,444 | Other | 17,321 | 16,782 |
| Palladium | 5,945 | 3,653 | | 99,499 | 117,911 |
| Other | 3,139 | 2,116 | Imports for consumption: | | |
| | 45,258 | 36,213 | Platinum | 148,809 | 127,832 |
| Secondary metals: | | | Palladium | 45,427 | 26,858 |
| Platinum | 55,926 | 44,654 | Other | 12,701 | 6,499 |
| Palladium | 12,680 | 13,489 | | 206,937 | 161,189 |
| Other | 3,600 | 6,148 | Exports: | | |
| | 72,206 | 64,291 | Unmanufactured | 59,567 | 33,635 |
| | | | Manufactures (except jewelry) | 2,874 | 796 |

[1] Subject to revision.

[2] In 1937 includes 9,255 ounces of new platinum from domestic sources, comprising 4,466 ounces derived from crude placer platinum, 28 ounces recovered from ore, and 4,761 ounces obtained from domestic gold and copper ores as a byproduct of refining; in 1938 includes 6,376 ounces of new platinum from domestic sources, comprising 2,590 ounces derived from crude placer platinum, 25 ounces recovered from ore, and 3,761 ounces obtained from domestic gold and copper ores as a byproduct of refining.



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In addition to now being the fourth largest source of supply of platinum metals, the United States is an important refining center and occupies a prominent position in the international platinum trade. In 1938, for example, 36,213 ounces of new platinum metals and 64,291 ounces of secondary platinum metals were recovered by domestic refiners, 161,186 ounces of unmanufactured platinum metals were imported for consumption, and 33,635 ounces of platinum and allied metals (ingots, sheets, wire, alloys, and scrap) and a considerable quantity of placer platinum were exported.

Despite the much larger output of domestic placer platinum, the bulk of the new platinum metals recovered by refiners in the United States in 1938, as in previous years, was derived from crude platinum from foreign sources, notably Colombia, as most of the Alaska platinum was refined abroad. Most of the refined new platinum metals now consumed in the United States come from the United Kingdom; the metals are recovered there chiefly as a byproduct in refining nickel-copper matte from the Sudbury district of Ontario and, to smaller extents, from matte from the Rustenburg district of the Union of South Africa and placer platinum from the Goodnews Bay district of Alaska.

*Shifts in sources of supply.*—The year 1938 probably marks the beginning of another period of transition in world production of platinum metals. During the present century and especially during the past two decades, the sources of supply of platinum metals have undergone several changes, owing chiefly to the decline in Russian output, the increased production in Colombia following the introduction of dredges, the successful recovery of platinum-group metals from the nickel-copper ore of the Sudbury (Ontario) district and from the oxidized and sulfide ores of the Transvaal, and the inauguration of mechanized equipment at the placer deposits in the Goodnews Bay district, Alaska.

Prior to 1900 the U. S. S. R. was the source of probably 90 percent of the platinum metals produced in the world, most of the remainder coming from Colombia. From 1900 to 1914 the U. S. S. R. contributed about 95 percent and Colombia the bulk of the remainder. The World War and the subsequent revolution had a depressing effect on the production of platinum metals in the U. S. S. R., and the output dropped to a low of about 20,000 ounces in 1921. Meanwhile, in Colombia the Government became stable, engineering methods were introduced, and production advanced fairly rapidly. Consequently, from 1915 to 1924 Colombia supplied about one-third of the world output, whereas the share of the U. S. S. R. fell to about one-half. Canada and the United States furnished the bulk of the remainder.

After several years devoted to experimental refining and to the development and selection of processes for the recovery of precious metals from the nickel-copper ore of the Sudbury (Ontario) district, a refinery was built in 1924 at Acton, England, to handle annually some 30,000 ounces of platinum metals. Refining at Acton was begun in 1925, and 16,980 ounces of platinum metals were produced there. As production of nickel and copper continued to mount, the annual capacity of the Acton refinery was enlarged to 300,000 ounces of platinum metals. In 1930 Canada recovered 68,000 ounces and became the second largest producer of platinum metals; in 1934, with an

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output of 200,000 ounces, it succeeded the U. S. S. R. as the world's largest producer. Canadian output increased to 259,000 ounces in 1937 and to 292,000 ounces in 1938.

Although osmiridium had been known to occur in the Witwatersrand district of the Transvaal since its discovery in 1892, it was not until 1921 that regular production was begun at several of the larger mines on the Far East Rand. From 510 ounces in 1921, output increased to 5,764 ounces in 1924 and has averaged 5,779 ounces annually during the decade 1929–38.

Almost simultaneously with the first recovery of osmiridium on a large scale on the Rand came the opening of the platinum deposits in the Waterberg district of the Transvaal, followed in the latter part of 1924 by the important discoveries in the Lydenburg district of the same Province. The first production (10,545 ounces) of platinum metals from these districts was recorded in 1926. The Waterberg district had a short-lived and altogether disappointing history. Important discoveries were made in the Potgietersrust field during 1925 and shortly thereafter in the Rustenburg district. In 1930 production of platinum metals in the Lydenburg, Potgietersrust, and Rustenburg districts had reached 55,342 ounces; in consequence, the Union of South Africa ranked as the third largest producing country, Colombia dropping to fourth.

Despite the fact that operations were discontinued in the Potgietersrust and Lydenburg districts after 1930, the Rustenburg district with a production of 47,163 ounces of platinum metals in 1931 still ranked slightly ahead of Colombia. In 1932 and 1933, however, production dropped to 9,246 and 2,386 ounces, respectively, owing to the drastic decline in sales, which caused suspension of operations in the Rustenburg district from April 1932 to July 1933. Consequently, Colombia regained third place in 1932 and retained it through 1935. With resumption of operations in August 1933 production in the Rustenburg district averaged about 34,000 ounces annually during the 3 years 1934–36. Meanwhile, with recognition of the necessity of treating sulfide ore, prompted by the approaching exhaustion of oxidized ore in the Rustenburg group of mines, experiments were carried out on the technical problems, apparently with much success. In 1937 the milling capacity of the Rustenburg plant was increased to 20,000 tons a month to provide crushing and sorting equipment for handling sulfidic ore, and a smelting plant to treat the concentrates produced from the sulfides was completed and put into operation in November. As a consequence, production in the Rustenburg district increased to 39,625 ounces in 1937 and reached an all-time record of 68,683 ounces in 1938.

Prior to 1935 the United States had contributed only a negligible quantity to the world output of platinum metals. For example, during the 10 years 1925–34 production averaged only about 8,300 ounces annually—1,000 ounces of placer platinum, 600 ounces from palladium-bearing copper ore, and 6,700 ounces as byproducts of gold and other metals. Although important deposits of placer platinum were discovered in the Goodnews Bay district of Alaska about 1926, only a small quantity was produced through 1933. Following consolidation of claims and installation of dragline scraper equipment in 1933, production of placer platinum in Alaska increased progressively from 3,101 ounces in 1934 to 9,823 ounces in 1937. Concurrently, by-

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product production from gold and other metals advanced from 2,335 to 10,578 ounces.

The successful use of dragline-scraper equipment in Alaska led to installation and completion of a dredge with 8-foot buckets late in 1937. Consequently, production of platinum metals in the United States jumped to 49,380 ounces in 1938—42,043 ounces of placer platinum, 7,247 ounces recovered from gold and copper refining, and 90 ounces from platinum-bearing ore. Thus, the United States attained the rank of fourth largest producer of platinum metals in 1938.

Figure 1 shows graphically the trend in world production of platinum metals from 1914 to 1938, inclusive. The prominent position of Canada since 1930 and especially since 1934 is strikingly revealed, as

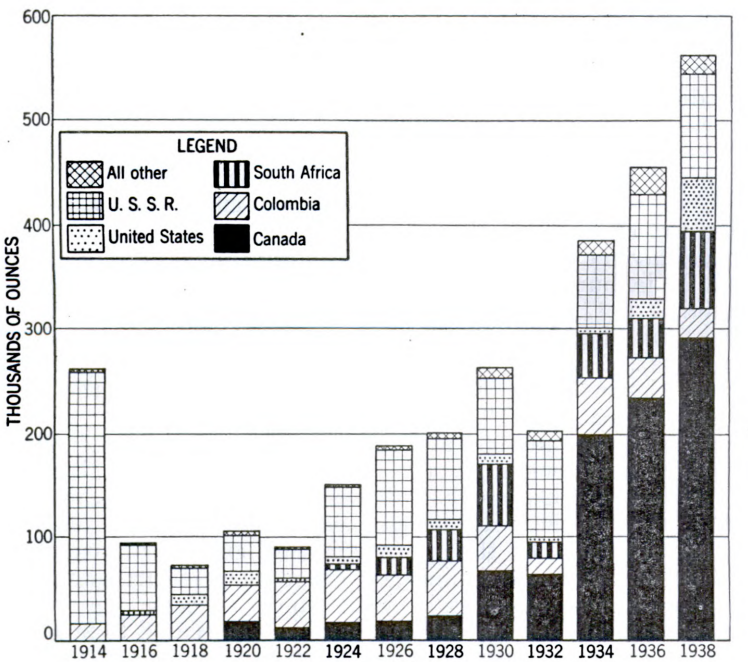


FIGURE 1.—Trend in world production of platinum metals, 1914-38.

well as the rise in production in the United States since 1936. The figures plotted for the U. S. S. R. for 1918, 1920, 1922, 1936, and 1938 are rough estimates of production of crude-platinum metals, whereas those for 1930, 1932, and 1934 are exports of refined platinum.

## CRUDE PLATINUM

*Production.*—Mine returns for 1938 indicate a production of 41,000 troy ounces of crude platinum in Alaska, 1,000 ounces in California, and 43 ounces in Oregon—a total of 42,043 ounces. Comparable figures for 1937 are 9,823 ounces in Alaska, 935 ounces in California, 3 ounces in Nevada, and 42 ounces in Oregon—a total of 10,803 ounces. Most of the production in Alaska came from placers in the Goodnews Bay district south of the mouth of the Kuskokwim River.

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Smaller quantities were recovered in placer-gold mining in the Koyuk district, Seward Peninsula. Some platinum metals, especially palladium, also were obtained by reworking the tailings from earlier lode mining in the Ketchikan district, Kasaan Peninsula. In California most of the platinum produced was a byproduct of dredges working the gold placers in Merced, Placer, Sacramento, Shasta, Tehama, Trinity, and Yuba Counties. The principal production in Oregon came from the ocean beach near Cape Blanco in Curry County.

Many gold and copper ores in the United States contain small quantities of platinum metals. In 1938, 7,247 ounces of platinum metals were recovered as a byproduct of refining gold and copper ores compared with 10,578 ounces in 1937.

*Purchases.*—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1938: Alaska, 3,658 ounces; California, 1,308 ounces; and Oregon, 27 ounces—a total of 4,993 ounces (7,537 ounces in 1937). Refiners in the United States also reported purchases of 28,324 ounces (34,703 ounces in 1937) of foreign crude platinum in 1938—23 ounces from Canada, 24,604 ounces from Colombia, 1,894 ounces from Ethiopia, 18 ounces from the Philippine Islands, and 1,785 ounces from the Union of South Africa.

*Prices.*—Buyers reported purchases at $20.94 to $33 an ounce for domestic and $20.15 to $31.34 an ounce for foreign crude platinum in 1938.

## REFINED PLATINUM METALS

*New metals recovered.*—Reports from refiners of crude platinum, gold bullion, and copper indicate that 36,213 ounces of platinum metals were recovered in the United States from these sources in 1938, a decrease of 20 percent from 1937. It is estimated that 10,599 ounces of the total output in 1938 were derived from domestic sources.

*New platinum metals recovered by refiners in the United States in 1938, by sources, in troy ounces*

| | Platinum | Palladium | Iridium | Osmiridium | Others | Total |
|---|---|---|---|---|---|---|
| Domestic: | | | | | | |
| Crude platinum | 2,590 | 23 | 383 | ---- | 266 | 3,262 |
| Ore | 25 | ---- | ---- | ---- | 65 | 90 |
| Gold and copper refining | 3,761 | 3,429 | 57 | ---- | ---- | 7,247 |
| | 6,376 | 3,452 | 440 | ---- | 331 | 10,599 |
| Foreign: Crude platinum | 24,068 | 201 | 807 | 384 | 154 | 25,614 |
| Total recovery: 1938 | 30,444 | 3,653 | 1,247 | 384 | 485 | 36,213 |
| 1937 | 36,174 | 5,945 | 1,998 | 640 | 501 | 45,258 |

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*New platinum metals recovered by refiners in the United States, 1934–38, in troy ounces*

| Year | Platinum | Palladium | Iridium | Osmiridium | Others | Total |
|---|---|---|---|---|---|---|
| 1934 | 43,392 | 1,471 | 1,588 | 585 | 238 | 47,274 |
| 1935 | 37,284 | 1,432 | 2,438 | 449 | 457 | 42,060 |
| 1936 | 39,728 | 4,682 | 1,678 | 541 | 317 | 46,946 |
| 1937 | 36,174 | 5,945 | 1,998 | 640 | 501 | 45,258 |
| 1938 | 30,444 | 3,653 | 1,247 | 384 | 485 | 36,213 |

*Secondary metals recovered.*—In 1938, 64,291 ounces of secondary platinum metals were recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum, a decrease of 11 percent from 1937.

*Secondary platinum metals recovered in the United States, 1934–38, in troy ounces*

| Year | Platinum | Palladium | Iridium | Others | Total |
|---|---|---|---|---|---|
| 1934 | 35,494 | 5,606 | 1,328 | 1,328 | 43,756 |
| 1935 | 47,107 | 7,852 | 2,191 | 1,975 | 59,125 |
| 1936 | 55,959 | 6,786 | 2,204 | 1,217 | 66,166 |
| 1937 | 55,926 | 12,680 | 2,320 | 1,280 | 72,206 |
| 1938 | 44,654 | 13,489 | 2,150 | 3,998 | 64,201 |

*Prices.*—Refiners reported the following prices for platinum in 1938: High $43, low $24, and average for the year $33.83 an ounce compared with $76, $28, and $46.84 an ounce, respectively, for 1937. They gave the following prices for palladium: High $28, low $17, and average for the year $23.21 an ounce compared with $28.50, $18, and $23.21 an ounce, respectively, for 1937.

*Consumption.*—The accompanying table shows sales of platinum metals to domestic consumers by refiners in the United States in 1938. The figures include sales of platinum metals recovered from crude platinum, gold bullion, copper and nickel bullion and matte, electrolytic muds, and scrap materials and sweeps; in addition they include sale of imported platinum metals that are handled by domestic refiners. Sales by refiners totaled 127,306 ounces in 1938 compared with 172,130 ounces in 1937.

The uses of the platinum-group metals are many and varied. The most widely used metal of the group is platinum itself, which constituted 87,568 ounces (68.8 percent) of the total platinum metals sold by domestic refiners in 1938. The largest use of platinum is in jewelry, where rich color and intrinsic value are desirable factors. About 51 percent (44,654 ounces) of the total sales of platinum by domestic refiners in 1938 went to the jewelry trade compared with 52 percent (49,848 ounces) in 1937. Although platinum and its companion metals are generally associated in the public mind with jewelry, they have diversified industrial uses. For example, the chemical industry, the second-largest consumer of platinum, purchased 14,328 ounces from domestic refiners in 1938 (18,300 in 1937), the dental industry 12,324 ounces (11,115 in 1937), and the electrical industry 5,645 ounces (9,465 in 1937).

Palladium, which is about half as common as platinum but less costly, is adapted to many of the same uses as platinum. It com-

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prised 35,073 ounces (27.5 percent) of the total platinum metals sold by domestic refiners in 1938. The largest consumer of palladium in 1938 was the dental industry, which purchased 18,833 ounces (54 percent of the total) from domestic refiners. The electrical and jewelry industries are the next largest consumers of palladium, and small quantities are used in the manufacture of chemical ware.

Iridium, best known as a hardening addition to platinum, ranks third among the platinum-group metals according to consumption. Of the total sales of platinum metals in 1938, 3,297 ounces (2.6 percent) were iridium.

Sales of the other platinum metals—rhodium (useful as an alloying element with platinum and palladium) and the still rarer ruthenium and osmium (used as hardening additions in special-purpose alloys)—are small and amounted to only 1.1 percent of the total for the group in 1938.

*Platinum metals sold by refiners in the United States in 1938, by domestic consuming industries, in troy ounces*

| Industry | Platinum | Palladium | Iridium | Others | Total | Percent of total |
|---|---|---|---|---|---|---|
| Chemical | 14,328 | 402 | 143 | 159 | 15,032 | 12 |
| Electrical | 5,645 | 10,447 | 616 | 231 | 16,939 | 13 |
| Dental | 12,324 | 18,833 | 148 | 34 | 31,339 | 25 |
| Jewelry | 44,654 | 5,356 | 2,358 | 316 | 52,684 | 41 |
| Miscellaneous and undistributed | 10,617 | 35 | 32 | 628 | 11,312 | 9 |
| | 87,568 | 35,073 | 3,297 | 1,368 | 127,306 | 100 |

The apparent consumption of platinum in the United States, as calculated from statistics on production, imports, and exports, is given in the following table.

*Apparent consumption of platinum in the United States, 1936–38, in troy ounces*

| Year | Recovered by domestic refiners | | | Imports of ingots, bars, sheets, or plates | Exports (unmanufactured and manufactures, estimated) | Apparent consumption |
|---|---|---|---|---|---|---|
| | Primary | Secondary | Total | | | |
| 1936 | 39,728 | 55,959 | 95,687 | 52,013 | 46,000 | 101,700 |
| 1937 | 36,174 | 55,926 | 92,100 | 62,052 | 50,000 | 104,000 |
| 1938 | 30,444 | 44,654 | 75,098 | 44,091 | 27,000 | 92,000 |

*Stocks.*—On December 31, 1938, 117,911 ounces of platinum metals were in the hands of refiners compared with 99,499 ounces at the end of 1937.

*Stocks of platinum metals in the hands of refiners in the United States, Dec. 31, 1934–38, in troy ounces*

| Year | Platinum | Palladium | Iridium | Others | Total |
|---|---|---|---|---|---|
| 1934 | 41,370 | 26,377 | 8,269 | 7,905 | 83,921 |
| 1935 | 50,265 | 27,807 | 9,202 | 6,273 | 93,547 |
| 1936 | 56,886 | 29,853 | 8,943 | 8,235 | 103,917 |
| 1937 | 60,236 | 21,942 | 9,785 | 7,536 | 99,499 |
| 1938 | 71,058 | 30,071 | 8,041 | 8,741 | 117,911 |

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## FOREIGN TRADE [1]

*Imports.*—Imports into the United States of platinum metals were 161,189 ounces in 1938, compared with 206,937 ounces in 1937. The principal sources of imported platinum metals in 1938 were the United Kingdom (101,987 ounces), the U. S. S. R. (31,431 ounces), and Colombia (22,251 ounces). Imports of palladium (chiefly from the United Kingdom) decreased to 26,858 ounces in 1938 from 45,427 in 1937.

*Platinum metals imported for consumption in the United States, 1934–38*

| Year | Troy ounces | Value | Year | Troy ounces | Value |
|---|---|---|---|---|---|
| 1934 | 174,312 | $4,157,518 | 1937 | 206,937 | $7,418,364 |
| 1935 | 164,149 | 4,228,022 | 1938 | 161,189 | 4,366,912 |
| 1936 | 210,440 | 5,996,034 | | | |

*Platinum metals imported for consumption in the United States, 1937–38, by metals*

| Metal | 1937 | | 1938 | |
|---|---|---|---|---|
| | Troy ounces | Value | Troy ounces | Value |
| Platinum: | | | | |
| Ores of platinum metals (platinum content) | 1,186 | $43,481 | 3,263 | $71,504 |
| Grain and nuggets | 24,405 | 922,795 | 26,176 | 688,166 |
| Sponge and scrap | 61,152 | 1,834,294 | 54,299 | 1,496,491 |
| Ingots, bars, sheets, or plates not less than ⅛-inch thick | 62,052 | 3,141,910 | 44,091 | 1,371,246 |
| | 148,795 | 5,942,480 | 127,829 | 3,627,407 |
| Manufactures of, not jewelry | 14 | 676 | 3 | 150 |
| Iridium | 5,568 | 531,537 | 1,717 | 118,849 |
| Osmiridium | 3,306 | 84,203 | 2,501 | 61,391 |
| Osmium | 366 | 14,317 | 440 | 16,349 |
| Palladium | 45,427 | 742,081 | 26,858 | 448,152 |
| Rhodium | 2,925 | 86,863 | 1,613 | 87,276 |
| Ruthenium | 536 | 16,207 | 228 | 7,338 |
| | 206,937 | 7,418,364 | 161,189 | 4,366,912 |

*Platinum metals (unmanufactured) imported for consumption in the United States in 1938, by countries, in troy ounces*

| Country | Platinum | | | | Iridium | Osmium and osmiridium | Palladium | Rhodium and ruthenium | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Ores of platinum metals (platinum content) | Grain and nuggets | Sponge and scrap | Ingots, bars, sheets, or plates not less than ⅛-inch thick | | | | | |
| Argentina | | | 237 | | | | | | 237 |
| Canada | | | 737 | 21 | 2 | | 101 | | 861 |
| Colombia | 842 | 21,409 | | | | | | | 22,251 |
| Ethiopia | 2,412 | 215 | | | | | | | 2,627 |
| Japan | | | 175 | | | | | | 175 |
| Netherlands | | | | 12 | | | | | 12 |
| Norway | | | 930 | | 425 | | 69 | | 1,424 |
| Panama | | | 2 | | | | | | 2 |
| Philippine Islands | | 18 | | | | | | | 18 |
| Switzerland | | | | 85 | | | | | 85 |
| Union of South Africa | | | 5 | 71 | | | | | 76 |
| U. S. S. R. | | | | 31,431 | | | | | 31,431 |
| United Kingdom | 9 | 4,534 | 52,213 | 12,471 | 1,290 | 2,941 | 26,688 | 1,841 | 101,987 |
| | 3,263 | 26,176 | 54,299 | 44,091 | 1,717 | 2,941 | 26,858 | 1,841 | 161,186 |

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Exports.*—Exports of unmanufactured platinum metals totaled 33,635 ounces in 1938, of which Germany took 8,345, France 6,906, Argentina, 6,862, and Japan 6,159 ounces.

*Platinum and allied metals exported from the United States, 1934–38*

| Year | Unmanufactured | | Manufactures of, except jewelry | |
|---|---|---|---|---|
| | Troy ounces | Value | Troy ounces | Value |
| 1934 [1] | 1,897 | $83,337 | 759 | $35,456 |
| 1935 [1] | 3,271 | 105,895 | 1,954 | 84,601 |
| 1936 | 55,454 | 2,069,205 | 2,590 | 123,891 |
| 1937 | 59,567 | 2,908,552 | 2,874 | 100,944 |
| 1938 | 33,635 | 1,156,644 | 796 | 31,111 |

[1] Excludes exports by parcel post.

*Platinum and allied metals exported from the United States in 1938, by countries*

[Includes exports by parcel post]

| Country | Unmanufactured (ingots, sheets, wire, alloys, and scrap) | | Manufactures of, except jewelry | |
|---|---|---|---|---|
| | Troy ounces | Value | Troy ounces | Value |
| Argentina | 6,862 | $241,998 | | |
| Brazil | 134 | 5,635 | 86 | $3,326 |
| Canada | 774 | 40,801 | 28 | 2,103 |
| China | 878 | 27,198 | 3 | 149 |
| Cuba | 214 | 7,438 | 18 | 1,060 |
| France | 6,906 | 239,435 | | |
| Germany | 8,345 | 261,752 | | |
| Japan | 6,159 | 218,339 | | |
| Palestine | 52 | 1,839 | 554 | 18,987 |
| Turkey | 537 | 15,400 | | |
| United Kingdom | 2,628 | 90,498 | 8 | 324 |
| Other countries | 146 | 6,311 | 99 | 5,162 |
| | 33,635 | 1,156,644 | 796 | 31,111 |

## PRODUCTION IN FOREIGN COUNTRIES

*Belgian Congo.*—The production of platinum and palladium in the Belgian Congo was 2,122 and 12,507 ounces, respectively, in 1937 compared with 3,183 and 12,571 ounces in 1936.

*Canada.*—Recoveries of platinum metals from the nickel-copper ores of the Sudbury district of Ontario were 161,310 ounces of platinum and 130,893 ounces of other platinum-group metals in 1938 compared with 139,355 ounces of platinum and 119,829 ounces of other platinum-group metals in 1937.[2] Sales of platinum metals by the International Nickel Co. of Canada, Ltd., were 193,195 ounces in 1938 compared with 188,756 ounces in 1937.

Placers in British Columbia yielded only 7 ounces of stream platinum in 1938 compared with 22 ounces in 1937.

*Colombia.*—Colombia exported 29,460 ounces of crude platinum in 1938 (29,315 in 1937). Of the 1938 exports, 52 percent went to the

[2] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada During the Calendar Year 1938: Ottawa, 1939.



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United States, 47 percent to Germany, and the remainder to France and Japan.

The South American Gold & Platinum Co. produced 20,714 ounces of crude platinum and 63,622 ounces of crude gold in 1938 compared with 18,345 ounces of crude platinum and 42,956 ounces of crude gold in 1937.

*Germany.*—Although the output of platinum metals in Germany is confined to small quantities of platinum and palladium recovered as byproducts in the treatment of copper ores, the country is important in the international platinum trade. Imports of platinum metals and alloys into Germany were 140,482 ounces in 1938 (121,076 ounces in 1937). The chief sources of supply in 1938 were Great Britain (69,388 ounces), the Netherlands (15,268 ounces), the United States (12,423 ounces), and Colombia (12,011 ounces). Exports of platinum metals and alloys from Germany were 32,569 ounces in 1938, of which 18,323 ounces went to Switzerland.

*Platinum metals and alloys imported into and exported from Germany, 1934–38, in ounces*

| Year | Imports | Exports | Year | Imports | Exports |
|---|---|---|---|---|---|
| 1934 | 73,641 | 72,304 | 1937 | 121,076 | 23,512 |
| 1935 | 84,981 | 102,288 | 1938 | 140,482 | 32,569 |
| 1936 | [1] 525,883 | 32,553 | | | |

[1] Includes platinum sweeps, electrolytic muds, used-up platinum contact material, and scrap.

*Union of South Africa.*—According to the Department of Mines and Industries, sales of platinum metals in South Africa in 1938 were 38,862 ounces valued at £223,776 (£5.76 an ounce) compared with 30,125 ounces valued at £237,663 (£7.89 an ounce) in 1937. The average composition of the product shipped in 1937 was platinum 72.53 percent, palladium 19.78 percent, iridium 0.20 percent, osmium and osmiridium 0.12 percent, ruthenium 1.72 percent, and gold 5.65 percent.

The enlarged plant at Rustenburg of Potgietersrust Platinum, Ltd., for handling sulfidic ores was brought into full operation in July 1938.[3] Flotation concentrates are now smelted on the property in a blast furnace and subsequently reduced in bulk by a converter. The matte is shipped to England for further treatment.

Sales of osmiridium in 1938 were 5,233 ounces valued at £34,110 (£6.52 an ounce) compared with 5,667 ounces valued at £37,254 (£6.57 an ounce) in 1937. The average composition of the product shipped in 1937 was osmium 29.92 percent, iridium 26.35 percent, ruthenium 13.48 percent, platinum 11.27 percent, gold 2.51 percent, rhodium 0.48 percent, and undetermined 15.99 percent.

*U. S. S. R.*—No authentic statistics are available on the production of platinum in the U. S. S. R. in recent years. However, it is generally estimated that an annual output of 100,000 ounces of crude platinum has been maintained.

[3] South African Mining and Engineering Journal, vol. 69, pt. 2, December 10, 1938, p. 434.

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## WORLD PRODUCTION

*World production of platinum and allied metals, 1934–38, in troy ounces*

[Compiled by M. T. Latus]

| Country and product | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia: | | | | | |
| New South Wales: Placer platinum | 180 | 98 | 47 | 46 | (1) |
| Tasmania: Placer osmiridium | 488 | 235 | 281 | 586 | 191 |
| Belgian Congo: From refineries: | | | | | |
| Palladium | 3,569 | 5,144 | 12,571 | 12,507 | (1) |
| Platinum | 1,254 | 965 | 3,183 | 2,122 | (1) |
| Canada: | | | | | |
| Placer platinum | 53 | 39 | 20 | 22 | 7 |
| From refineries: [2] | | | | | |
| Platinum | 116,177 | 105,335 | 131,551 | 139,355 | 161,310 |
| Other platinum metals | 83,932 | 84,772 | 103,671 | 119,829 | 130,893 |
| Colombia: Placer platinum (exports) | 54,216 | 38,020 | 38,333 | 29,315 | 29,460 |
| Ethiopia: Placer platinum | 5,644 | 6,320 | 8,038 | (1) | (1) |
| Japan: Placer platinum | 118 | 51 | 34 | (1) | (1) |
| New Zealand: Placer platinum | ------- | 14 | 29 | 55 | (1) |
| Panama: Placer platinum | ------- | 16 | 19 | 267 | (1) |
| Papua: [3] | | | | | |
| Placer platinum | 96 | 46 | 21 | 20 | 41 |
| Placer osmiridium | 4 | 9 | 17 | 8 | 4 |
| Sierra Leone: Placer platinum | 474 | 750 | 484 | 308 | 180 |
| Union of South Africa: | | | | | |
| Platinum (content of platinum metals) [4] | 26,369 | 19,954 | 19,751 | 17,776 | 18,253 |
| Concentrates (content of platinum metals) [4] | 11,372 | 11,317 | 13,163 | 21,849 | 50,428 |
| Osmiridium [5] | 5,088 | 5,047 | 5,431 | 5,790 | 5,354 |
| U. S. S. R.: Placer platinum [6] | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| United States: | | | | | |
| Placer platinum | 3,720 | 9,069 | 9,785 | 10,803 | [7] 42,043 |
| Ore (content of platinum metals) | ------- | ------- | 110 | 124 | 90 |
| From refineries: [8] | | | | | |
| Platinum | 1,062 | 1,361 | 4,443 | 4,761 | 3,761 |
| Other platinum metals | 1,273 | 1,122 | 4,541 | 5,817 | 3,486 |

[1] Data not yet available.
[2] Recovered from nickel-copper mattes.
[3] Year ended June 30 of year stated.
[4] Produced from platinum ores.
[5] Produced from treatment of gold ores on the Rand.
[6] Approximate production.
[7] Subject to revision.
[8] New platinum metals recovered in gold and copper refining of domestic materials.

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# MINOR METALS

By Paul M. Tyler

SUMMARY OUTLINE


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During the last decade or two it has become increasingly apparent that the atoms of all the 92 elements can be broken down into smaller atoms, modifying their characteristics and changing their identities. Conversely, it has been found that lighter elements can be made into heavier ones, and new elements have been created that are heavier than any found in nature.

In January 1939, probably first in Copenhagen but almost simultaneously in three American laboratories, it was proved that uranium actually could be cracked in two, and, furthermore, that almost inconceivable amounts of energy (in the neighborhood of 200,000,000 volts) were thus released. A few days later thorium, another heavy element (atomic weight, 232), was split by the million-volt atom-smashing machine at the Carnegie Institution of Washington, and similar results were reported from independent experiments at Johns Hopkins University and (earlier) at the Institute for Theoretical Physics in Copenhagen.

Part of the novelty of these discoveries lies in the hint they give as to methods of tapping the tremendous store of atomic energy, the force that holds all matter together. Previously such concentrations of energy had been known to be produced only in the interior of the sun and the stars. Almost as important is the magnitude of the change in the nature of the atoms. Atom smashing hitherto had succeeded only in abrading or chipping off tiny fragments, producing changes somewhat akin to the spontaneous degeneration of radioactive elements into more or less related substances, but in this latest transmutation the properties of each of the new elements are entirely different from those of the parent element.

The practical importance of these discoveries is yet to be learned. They give promise of the fabrication of rare elements from common ones and the capture for use as industrial power of the limitless, yet still inaccessible, energy sealed in the atoms of terrestrial matter. Enabled now to reshape atomic structures so violently, scientists are better equipped to solve other mysteries of the constitution of matter and to explore further the mechanics of creation of the universe.



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Masurium (element 43), one of the products of this major cleavage of uranium, is an element so rare in nature that the claim of the Noddacks that they discovered it some years ago has been questioned. Conclusive verification is believed also to be lacking of the existence of illinium (61), of eka-iodine or "alabamine" (85), and of eka-cesium or "virginium" (87). Obviously none of these elements is likely to be found on the earth's surface except in amounts too minute to be important commercially. Knowledge of rhenium likewise would be confined to spectroscopic data and scientific conjecture had it not chanced to be concentrated in the slime from an industrial process. Only this accident makes it possible to produce rhenium at a potential rate of 1 or 2 tons a year when its richest known ore carries only a fraction of 1 percent of the element. A German journal (Naturwissenschaften) is credited [1] with the suggestion that stable isotopes of elements 43 and 61 may not actually exist; in such case further attempts to isolate them even in a laboratory are foredoomed to failure.

It is impracticable for the Bureau of Mines to report faithfully each year the advances along all frontiers of scientific investigation of metals. For certain of the rarer metals it can scarcely keep pace with quasi-industrial developments. An attempt was made in Minerals Yearbook, 1937, to review the commercial status of every one of the metals, but subsequent reviews for the minor metals mention only those for which new information has come to the author of the chapter. More specifically it may be said that the omission of reference to certain elements in the following review does not imply that such elements are deemed less important commercially or less significant scientifically than those that are discussed in some detail.

## BERYLLIUM

Notwithstanding the great interest displayed by several chemical-manufacturing companies, inventors, and investors and the various rumors of new enterprises engaged in producing beryllium on a more or less large scale, the world output of beryl probably still fails to exceed 750 tons a year. In the United States the commercial supply of the metal and its commercial compounds continues to come entirely from two companies—the Beryllium Corporation of Pennsylvania (Andrew Gahagan, president), Temple (near Reading), Pa.; and the Brush Beryllium Corporation (C. B. Sawyer, president), 3714 Chester Avenue, Cleveland, Ohio.

The Beryllium Corporation of Pennsylvania, which has a cooperative arrangement with Siemens & Halske, the leading German beryllium producer, for the exchange of information and patents, recently has completed a fabricating plant at Reading, Pa., the first to be designed especially for rolling and drawing beryllium alloys. In 1935 this company transferred its plant activities from Michigan to Pennsylvania and engaged in the production of nonsparking tools and other beryllium-copper castings but continued to sell a major portion of its output in the form of master alloys to the American Brass Co. and the Riverside Metal Co. for remelting and fabrication. Under the new set-up the Beryllium Corporation of Pennsylvania, however, will be in a position to supply all kinds of beryllium and copper

[1] Chemistry and Industry (London), Elements Still Missing: Vol. 57, No. 32, August 6, 1938, p. 740.

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products, including sheet, strips, wire, and tubing as well as castings, finished alloy, ingots, and master alloys. Inasmuch as it also will produce sheet bars and billets from the molten alloys, the new policy may result in other fabricators undertaking the manufacture of some of these products, thereby broadening the market. The equipment of the new fabricating plant is much heavier than that hitherto employed for forming the hardest copper alloys, and all operations from the purchase of the ore to the marketing of the products to the ultimate consumer will be under the technical control of the one company. The capacity of the plant exceeds anticipated needs at present and can be increased readily as required.

Price has always been a deterrent to more rapid expansion in the use of beryllium. The price of the beryllium content of master alloys was reduced a year ago from $30 to $23 a pound of Be content, but the base price of finished beryllium-copper products (about 2.25 percent Be) had to be increased from 89 cents to $1.12 a pound owing to the difficulties of fabrication. According to information furnished to the Bureau of Mines it is expected that this price can soon be reduced. To meet the demand for a material intermediate in physical properties between standard beryllium copper and phosphor bronze an entirely new group of alloys is being offered. One series contains 0.4 to 0.5 percent Be, 2 or 3 percent cobalt, and the rest copper; another is similar, except that chromium replaces cobalt; and still another comprises beryllium-nickel alloys that heretofore have not been manufactured commercially in the United States.

Possibly the most significant development in the beryllium industry during 1938 was the interest in the wider use of the element in munitions, more specifically in vital parts of airplane engines. Of interest also is the employment of beryllium or, better, an 80-percent ferroberyllium, for cementing steel. Beryllium dissolves readily in gamma iron, and by a suitable technique a maximum penetration of 20 to 25 millimeters can be obtained—with the case-hardened surface showing a hardness of over 1,000 Brinell.[2] Beryllium oxide films may be used to prevent tarnish on silver, although preliminary reports [3] indicate that aluminum may be as satisfactory, and of course it is much cheaper.

Among alloys in practical use are nickel with 2.5 percent Be, which hardens to 600 Brinell after quenching from 1,100° C. and drawing at 400° to 500° C., and 18-carat gold, which beryllium hardens to 300 Brinell. Steel with 36 percent nickel and 1 percent beryllium is rustless and machinable, but like Invar it does not expand or contract when heated. Beryllium forms a eutectic with iron at 9.2 percent Be and 1,150° C., and this alloy can be refined in grain by heat treatment. Tin-beryllium alloys containing 0.2 percent Be are 20 percent less ductile than pure tin but are slightly harder and have improved bending strength. When the proportion of beryllium is increased primary crystals of beryllium form in a ground mass containing only a few tenths of 1 percent Be. Beryllium additions to aluminum-magnesium alloys prevent loss of Mg by oxidation during melting, prevent surface defects on castings, and inhibit discoloration during heat treatment. They tend, likewise, to promote coarser structure,

[2] Kontorovich, I. E., Diffusion of Beryllium in Iron Alloys: Metallurgy, vol. 12, No. 6, 1937, pp. 21-30; Chem. Abs. vol. 32, No. 14, July 1938, p. 5356.
[3] Price, L. E., and Thomas, G. J., The Tarnishing of Silver and Silver Alloys and Its Prevention: Jour. Inst. Metals, vol. 63, 1938. Reviewed in Min. and Met., vol. 19, November 1938, p. 495.

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increasing the time of heat treatment and decreasing mechanical properties, but this disadvantage is neutralized by adding a little titanium. Only 0.02 percent Be is required in these alloys, and it is obtained from a master alloy containing about 90 percent Be and 7 to 12 percent Mg made by adding the double fluoride of these metals to the surface of an aluminum bath at about 1,350° F.[4]

The search for uses of other alloys and even of the metal itself continues unabated, but practical sales effort in the United States hitherto has been focused mainly on expanding the demand for beryllium-hardened copper in electrical devices and small machines. This alloy, which is soft and ductile before heat treatment and easily fabricated, can be made hard and high in elastic properties by simple one-stage treatment. Its exceptional resistance to fatigue and good electrical conductivity make it a valuable material for flat and coil springs. To illustrate the remarkable life of beryllium copper, one manufacturer reports that vibrator springs, heavily stressed 230 times per second and subjected to severe temperature changes, exhibited no measurable alteration in physical or electrical performance after 2 billion vibrations.

About 1 ton of beryllium worth 3,000 francs per kilogram (about $40 a pound) is now being produced annually in France. A leading electrical company makes it by electrolysis in a fluoride bath from beryl obtained near Limoges and Autun, supplemented by supplies from Madagascar. Italy, Japan, and possibly other countries are credited with small or occasional outputs, but the United States and Germany produce the bulk of the world beryllium supply in the form of alloys.

Beryl occurrences have been reported in various parts of the United States, but few mines outside of the Black Hills, S. Dak., have produced as much as a carload, and most of the domestic production has been obtained as a byproduct of feldspar, lithium, or rare-metal ore mining. No statistics of domestic output are available. A substantial part of domestic consumption in recent years has been supplied by imports, which in 1938 amounted to 146 short tons valued at $5,990, all from British India and Argentina excepting a 10-ton lot from the Union of South Africa. In 1937 imports were 182 tons valued at $8,031, and in 1936 they were 162 tons valued at $6,681.

Deposits of beryl in U. S. S. R. have recently been reviewed.[5] The most important deposit, which also yields emeralds, is some 70 kilometers from Sverdlovak, in the Urals; the beryl is associated with talc, mica, chlorite, and actinolite schists. In a recent report, which confirms previous reports, Hungarian bauxites are found [6] to contain only 0.005 to 0.01 percent BeO, far too little to encourage hopes of industrial recovery of the beryllium.

More beryl is being offered than can be consumed at present demand levels, and the price is still quotable at $30 a ton f. o. b. mines for 10- to 12-percent ore and up to $55 a ton delivered at consuming plants for higher grades. These figures correspond to an ore cost of approximately $1.25 a pound of recovered beryllium metal, which could be increased substantially if necessary to stimulate mining and still per-

[4] Gauthier, G., Improvement of Cast Aluminum-Magnesium Alloys by Additions of Beryllium and Titanium: Foundry Trade Jour. (London), vol. 59, November 17, 1938, p. 373.

[5] Sherbakov, D., Beryllium Deposits in U. S. S. R.: Redkie Metal. No. 1, 1936, pp. 35–42. Neues Jahrb. Mineral. Geol., Ref. II, 1937, pp. 667–669; Chem. Abs., vol. 32, No. 16, Aug. 20, 1938, pp. 6192–6193.

[6] Szelenyi, Tibor, Beryllium in Bauxites: Math. naturw. Anz. ungar. Akad. Wiss., vol. 65, 1937, pp. 231–246; Chem. Abs., vol. 32, No. 5, March 10, 1938, p. 1616.

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mit the metal to be made at well under $5 a pound. Many people have labored under the delusion that beryllium cannot be sold at less than $23 a pound, even in its master alloys, because conversion costs are excessively high; this is not true. Suitable methods of reducing the metal from its ores have already been worked out, and they are not inherently expensive. On the other hand, very large sums have been spent upon research, educational campaigns, patents, and other expenses incident to the development of a new metal, and the burden of these expenses has had to be borne by a relatively small volume of actual sales. It is confidently asserted that $10 a pound is an early possibility, provided the scale of operations can be substantially increased. It is somewhat less certain what can be done about lowering prices to the ultimate consumer because less is known as to the cost of manipulating the alloys; however, a base price of 75 cents for the standard 2.25-percent copper alloy is mentioned tentatively as being in sight, and eventual reduction to not more than double the cost of phosphor bronze seems likely.

## CALCIUM

Calcium is recognized as a coming metal and already has begun to find industrial applications, especially as a scavenger and alloying element. The United States is the largest user, but France and Germany are the leading producers. Imports of calcium in 1938, almost all from France, amounted to 41,299 pounds valued at $16,144, as against 23,767 pounds and $10,087 in 1937. Imports of calcium alloys, however, declined, those of calcium silicide (a steel-making alloy imported chiefly from Norway but also from France) being reduced to 701 short tons valued at $77,003, from 1,876 tons and $205,173 in 1937.

The present status of the industry has been reviewed recently and comprehensively in a French paper.[7] Owing to its relatively high cost (65 cents to $1.50 a pound), calcium has not found general use in steel making, but its use for deoxidizing stainless and special-alloy steels increased in 1938. Either the metal or the hydride is employed as a reducing agent in the production of sundry rare metals, such as titanium, vanadium, and uranium.

## COLUMBIUM AND TANTALUM

World production of tantalum and columbium ores rose from about 6 tons in 1930 to 200 tons in 1934 and probably to about 750 tons annually in 1937 and 1938. This expansion is due mostly to the increased output of columbite for use chiefly in making ferrocolumbium. Columbium-bearing stainless steels successfully withstand high temperature, are more weldable than ordinary stainless steel, and are more resistant to corrosion. In 4- to 6-percent chromium steel, columbium reduces air hardening and stabilizes the physical properties, especially impact strength. The metal itself is very similar in general properties to tantalum, but when gas-free it is more ductile and can be more easily worked into wire and sheets. According to Kreuchen [8] the melting point of columbium is 2,500° C., more

[7] Bastien, P., Le Calcium: Fabrication, propriétés et applications métallurgiques: Chim. et ind., vol. 39, No. 4, April 1938, pp. 121–132T.

[8] Kreuchen, Dr. K. H., Niobium Metal: Chem. Fabrik, Nos. 41 and 42, 1937; Canadian Chem. and Process Ind., vol. 22, May 1938, p. 183.

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than 350° under that of tantalum. It resists gases as well as tantalum up to a temperature of 300° C. but burns in air at about 400° C. At high temperatures columbium hydride, a glass-hard material, is formed. Columbium shows good resistance to corrosion, except by hydrofluoric acid, concentrated sulfuric acid, concentrated hydrochloric acid, and strong alkalies; in virtually every instance chemical attack seems to be due to the action of hydrogen and the formation of the brittle hydride.

The great affinity of tantalum and columbium for all common gases has led to an extensive use of both metals in the vacuum-tube industry. The remarkable resistance to corrosion of tantalum explains its use in chemical-plant equipment, and the great hardness of carbides of tantalum and columbium has led to their increasing use in carbide compositions. One of the newer applications for tantalum is in a complete absorption system for producing hydrochloric acid. Tantaloy, an extremely hard tantalum alloy, is nonmachinable but is supplied in bars, rods, and other simple shapes for welding upon base metals. It is used principally in the chemical industries for spray nozzles and wear-resisting surfaces but is recommended also for general abrasion- and corrosion-resisting service, as well as for use in cutting tools, the purpose for which it was originally designed. Balke has covered the uses of these metals in some detail.[9] In a later paper [10] he describes methods for producing ductile bars of these metals by powder metallurgy. Tantalum carbide tool compositions have been discussed by McKenna.[11]

The world's tantalite has come principally from Western Australia; the Wodgina property in the Pilbarra field has produced 20 or 30 tons yearly from alluvial material below a pegmatite outcrop. The concentrates carry less than 10 percent $Cb_2O_5$ and average approximately 65 percent $Ta_2O_5$. Columbite recently has been produced, principally in connection with tin placer mining, in Nigeria, which reported shipments of 707 tons in 1937 and reserves approximating 10,000 tons.[12] The leading producer in 1937 was Jantar-Nigeria, which shipped 410 tons to the United States; a half-dozen other companies made shipments to England. During the last year or two the Belgian Congo has been described as a possible producer of both tantalum and columbium ores. Mathieu[13] expects this colony to become an important source of these minerals. The average tantalum content of the Belgian Congo deposits seems to be higher than that of the Nigerian product but lower than that of the product of the Pilbarra field in Western Australia. Tantalite has been found in Australia also at Grant's Creek 17 miles west of Forsyth, associated with albite in pegmatite; the importance of the occurrences in this area has not yet been determined.[14] In 1938 a production of 7 tons of tantalite valued at £1,742 was reported in Uganda.

In the United States, the main supply of tantalum ore has been imported from Australia and raw material for making ferrocolumbium

[9] Balke, C. W., Columbium and Tantalum: Ind. and Eng. Chem., Ind. Ed., vol. 27, No. 10, 1935, pp. 1166–1169.

[10] Balke, C. W., Ductile Tantalum and Columbium: Am. Inst. Min. and Met. Eng. Tech. Pub. 927, Metals Technol., vol. 5, No. 4, June 1938, 4 pp.

[11] McKenna, P. M., Tantalum Carbide Tool Compositions: Am. Inst. Min. and Met. Eng. Tech. Pub. 897, Metals Technol., vol. 5, No. 2, February 1938, 12 pp.

[12] Mining Journal (London), Nigerian Mining: Vol. 203, November 26, 1938, p. 1090.

[13] Mathieu, F. F., Les gisements des minerais de tantale et de niobium: Ext. from pubs. de l'Association des Ingenieurs de la Faculté Polytechnique de Mons 1er fascicule 1938, No. 64, pp. 49–139; Bureau of Mines Mineral Trade Notes, vol. 6, No. 6, June 20, 1938, pp. 24–25.

[14] Mining Magazine (London), vol. 58, No. 6, June 1938, p. 346.

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from Nigeria. In 1938 the imports of tantalite rose to 41,706 pounds valued at $80,092, compared with 20,897 pounds valued at $40,742 in 1937; the imports of columbite declined to 645,141 pounds valued at $228,078 from 922,654 pounds and $306,086 in 1937.

However, small lots of tantalum-bearing ores (chiefly columbo-tantalite) have come from New Mexico, Wyoming, Colorado, North Carolina, and Virginia and have also been reported in California, Connecticut, Maine, and South Carolina.[15] At present, the only important domestic sources of ore used for making tantalum metal are the deposits in the Black Hills of South Dakota, although there is a small output from Amelia, Va.

*Shipments of tantalum-bearing ores in the United States, 1934–38*

| Year | Pounds | Value | Year | Pounds | Value |
|---|---|---|---|---|---|
| 1934 | 2,425 | $968 | 1937 | 16,307 | $13,317 |
| 1935 | 7,681 | 4,521 | 1938 | 36,189 | 35,127 |
| 1936 | | | | | |

The first real interest in commercial production of tantalum ores other than as a byproduct was in 1927, when some good showings were opened up while a road was being graded through the east side of a pegmatite dike in connection with construction of a 150-ton concentrator for the Black Hills Tin Co. After the production of several tons of concentrates containing 38.7 to 57.0 percent $Ta_2O_5$ in 1928 and 1929, operations were discontinued until 1936 when amblygonite was identified on the dumps, which accordingly were worked over for lithium ores. The Fansteel Mining Co., a wholly owned subsidiary of the Fansteel Metallurgical Corporation, obtained a lease on the property in February 1937, sunk a 60-foot shaft, and drifted southward under the ore, which is mined by open pit, dropped through raises, and eventually hoisted from the shaft. Approximately half the tonnage mined is sorted out as waste, the remainder going to a small mill, where it is crushed to minus 8-mesh and tabled. The geology of the occurrence has been discussed by Hess and Bryan.[16]

## INDIUM

No metal costing almost $30 an ounce can hope to enter the industrial field unchallenged, but the systematic search for uses for indium seems likely to bear fruit in the relatively near future. In a comprehensive review of available information on indium published in 1938,[17] Grasselli Chemical Co. technologists report that it is doubtful whether any of the numerous suggested uses have yet been adopted on a commercial scale. The most promising outlet, they believe, is in precious-metal alloys for jewelry and dental work, in which indium increases resistance to corrosion. Silver-indium alloys containing 1 to 25 percent indium have been developed for plating silverware to prevent tarnishing, and a dental amalgam base (patented) containing

[15] Johnson, A. I., Tantalum from the Black Hills: Eng. and Min. Jour., vol. 139, No. 11, November 1938, pp. 39–42.

[16] Hess, F. L., and Bryan, B., Jr., The Pegmatites at Tinton, S. Dak.: Bureau of Mines Rept. of Investigations 3404, June 1938, 19 pp.

[17] Lawrence, R. E., and Westbrook, L. R., Indium; Occurrence, Recovery, and Uses: Ind. and Eng. Chem., vol. 30, No. 6, June 1938, pp. 611–614.

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95 percent mercury and 5 percent indium is claimed to improve the mechanical properties of the filling. Indium further lowers the melting point of low-melting alloys; addition of 18 percent indium to Wood's metal yields a metal that is fluid at 46.5° C. Other potential uses include bearing metals (especially those utilizing the new technique of plating on and diffusion into cadmium alloys, as described by Smart [18]), mirrors, medicine, and glass making. Indium oxide and sulfur compounds impart light-yellow to dark-yellow amber colors to glass, and only 0.05 percent indium oxide is said to give a beautiful yellow glass. Binary indium-tin alloys have been investigated recently; they show higher resistance to both fatigue and corrosion, yet are soft and ductile. Other alloys investigated previously include those with copper, gallium, lead, lithium, silver, sodium, tellurium, and zinc, respectively. The search for commercial outlets is still being pushed vigorously because potential supplies are relatively large.

With the introduction of various wet methods of extracting zinc, indium and certain other rare metals have become readily available if needed. Indium and sundry associated metals are extracted from the complex waste mud from these processes with hot dilute sulfuric acid and reprecipitated by treating the solution with zinc. The resulting sponge, which contains not only indium but also cadmium and a little lead, nickel, tin, and copper, is filtered off and leached first with not quite enough hot dilute acid to dissolve the cadmium. Further leaching of the remaining sponge dissolves other metals, and after lead sulfate and other insoluble matter have been filtered out this second solution is treated with an excess of ammonia thereby precipitating indium hydroxide, which can be separated, washed, and eventually ignited to trioxide. Metallic indium of 97 to 98.5 percent purity is made directly from this impure trioxide by an electrolytic method and can be purified further if required.

## MESOTHORIUM

Mesothorium is used medicinally in the treatment of cancer and skin diseases and in luminous paints as a radium substitute. Actually almost all material so designated contains more radium than mesothorium, but as the latter is approximately 30 times as radioactive the product is sold as mesothorium. There are no official statistics of domestic production or exports. Imports are classified as "radioactive substitutes" and shown in value only. Ordinarily they are not very important, but in 1938 they jumped to $5,746 compared with $711 in 1937. The bulk of the small domestic consumption is supplied by domestic sources. As most users require a National Bureau of Standards certificate before they purchase material, the following record of such tests affords a fair measure of the output and demand in the United States.

Mesothorium is produced in this country from the residues of monazite sand after thorium and cerium have been extracted for use in gas mantles. The extraction process is very much like that for radium. The residues are digested in hot concentrated sulfuric acid and treated with barium salts to form a precipitate of mesothorium-barium sulfate, which is filtered, redissolved by treatment with sodium carbonates, and purified by a long series of fractional crystallizations.

[18] Smart, C. F., Indium-Treated Bearing Metals: Am. Inst. Min. and Met. Eng. Tech. Pub. 900, Metals Technol., vol. 5, No. 3, April 1938, 13 pp.

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*Mesothorium tested by National Bureau of Standards, 1928–38*

| Year | Number of specimens | Milligrams | Year | Number of specimens | Milligrams |
|---|---|---|---|---|---|
| 1928 | 12 | 521 | 1934 | 29 | 1,026 |
| 1929 | 6 | 242 | 1935 | 24 | 612 |
| 1930 | 12 | 449 | 1936 | 13 | 331 |
| 1931 | 6 | 286 | 1937 | 21 | 416 |
| 1932 | 1 | 41 | 1938 | 18 | 373 |
| 1933 | 8 | 136 | | | |

The only known foreign producer is Deutsche Gasglublicht Auergesellschaft, Frankfort on the Main, Germany, a leading gas-mantle manufacturer.

## RADIUM AND URANIUM

Early in 1939 it was reported that a marketing agreement had been concluded between Union Minière du Haut Katanga (operating in the Belgian Congo) and Eldorado Gold Mines, Ltd. (Canada), for marketing radium, whereby the former will supply 60 percent and the latter 40 percent of world requirements. Some years ago an agreement was in effect between the Belgian company and the Czechslovak Government, but in recent reports no mention is made of outside production. The Joachimsthal (Jachymov) deposits in the Ore Mountains lie in territory ceded to Germany; they are of interest not only because they normally supply 1 to 3 grams of radium a year but also because they supplied the pitchblende that Mme. Curie employed in all her early work. Small quantities of radium ores are produced in the United States, the U. S. S. R., and Portugal.

Canada entered the ranks of radium producers with an output of 3.025 mg. in 1933 and became an important factor when its output rose to 15.54135 grams in 1936. By the middle of 1938 its operating rate had been stepped up to 1 gram of radium salts weekly, with a projected capacity of 85 grams yearly. The estimated output for the year was 70 grams compared to the 1937 total of 23.77014 grams. According to reports by the Dominion Bureau of Statistics (Ottawa), 25,486 tons of ore were hoisted during 1937 at the Eldorado mine, which yielded a total of 674.5 tons of concentrates and cobbed ore, comprising 475.3 tons of pitchblende-silver, 193.3 tons of silver-copper (flotation), and 5.9 tons of cobalt (cobbed) concentrates. Receipts of pitchblende concentrates at the company Port Hope (Ontario) refinery were 339 tons; but only 294 tons, yielding 302 tons of roasted ore, were put through the roasting and milling plant in 1937, and of the latter only 290 tons entered into the chemical treatment. Recovery of both radium and uranium was about 90 percent and of silver about 96 percent. It is stated that about 5.2 tons of uranium salts are recovered per gram of radium. Silver is marketed as silver sulfide to refineries in the United States, and the total value of all products was reported at $850,000 in 1937. This figure includes the value of radioactive lead, which was recovered in the form of lead sulfate to meet an industrial demand for radium D; the ore contains about 5 percent such lead. The company recently has offered radioactive lead oxide made from this lead, which is required for scientific and research purposes.

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Eldorado Gold Mines stock sold at $1.38 to $3.25 per share in 1938, compared with a maximum of $8.10 in 1933 when the property was still in the development stage. Ore reserves valued at $5,956,482 on December 1, 1937, were marked up to $7,000,000 in June 1938. The company report states that as of October 1, 1938, unfilled orders for radium exceeded $700,000, and sales during the first 9 months totaled $1,007,539, about 100 percent ahead of 1937. Mill costs at Port Hope have been cut 20 percent, and mining and concentrating costs at Great Bear Lake also have been reduced, whereas prices of uranium and uranium products have increased.

A few other occurrences of pitchblende have been reported in Canada. The Consolidated Mining & Smelting Co. did considerable development on claims near Common Lake, adjoining the Eldorado property to the northeast, but suspended its work in June 1936. Parcels of ore have been shipped from discoveries made several years ago at Beaverlodge and Hardisty Lakes about 100 miles to the south, and pitchblende was discovered in 1935 near Goldfields, on Lake Athabasca, where it occurs in narrow veinlets that also carry gold. Canada Radium Mines conducted underground exploration for radioactive minerals in pegmatite at Cheddar near Wilberforce in northern Hastings County, Ontario, but suspended this work in 1937. The Bear Exploration & Radium, Ltd., following much surface and underground development, made a test shipment of silver ore as early as 1934 from its property at Cameron Bay, Great Bear Lake. In 1938 this company was reorganized and refinanced by the Eldorado Mines, Ltd., and began producing concentrates.

Radium is sold in grades according to the percentage purity of the salt. The usual purity is 98 percent. For domestic transactions radium is compared at the National Bureau of Standards with the National Radium Standard, a duplicate of the international standard prepared by Mme. Curie and deposited in Paris. Other duplicates are found in leading capitals throughout the world. The measurement involves comparison of the electrical energy carried by the X-rays, and certificates are issued. During 1938 the National Bureau of Standards, under the supervision of Dr. L. F. Curtiss, tested 1,280 radium preparations with a radium content of 10.5 grams compared with 1,703 preparations containing 9 grams in 1937.

Imports of radium salts into the United States rose in 1938 to an all-time record of 38.75 grams valued at $787,025, compared with 15.29 grams valued at $377,659 in 1937. The previous record was only 21.97 grams in 1934, but owing to the somewhat higher prices then prevailing the valuation in that year was $1,082,462. Imports of uranium oxides and salts never exceeded 20,000 pounds a year until 1926 but have been increasing almost steadily to a peak of 341,040 pounds valued at $374,110 in 1936. After dropping to 203,473 pounds with a value of $258,417 in 1937, they advanced to a new high record of 376,708 pounds valued at $520,540 in 1938.

Radium salts are marketed either in the form of implants in gold or platinum needles containing 1 to 12½ mg. or in sealed tubes of glass, silver, or platinum containing 10 to 100 mg. Radon, or emanation, ordinarily is sold in gold implants or "seeds" 5 to 7 mm. long and 0.5 mm. in diameter. An outer case of lead is customarily employed to decrease danger of handling. Radium for radiograph testing of metals may be placed in small drum-shaped silver containers holding 100 mg.

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A recent proposal is to use tungsten shields which, owing to their greater density, may be more effective than those of other metals, including lead.

In some hospitals the radium is stored in solution, and only radon is collected and used.

"Radium Protection" (National Bureau of Standards Handbook H 23) is a manual of recommended precautions to be observed by those whose work involves handling of this dangerous element.

Radium is often handled in such minute quantities that occasional loss is inevitable—100 mg., the usual dose for treating cancer, would barely cover the head of a pin. Because it is worth roughly 18,000 times its weight in pure gold and especially because it menaces the lives of those who may unwittingly come into contact with its destructive rays, ingenious devices have been developed to recover it. About 20 of these devices—most of them home-made affairs using gold-leaf electroscopes—are in use in the United States, and of 107 reported losses 59 complete recoveries and 11 partial recoveries of radium have been made, according to an interesting article by Taft.[19]

The price of radium, after reaching $135 a milligram during the World War, was cut to $70 in 1923 and to $50 in 1930. The quotation since August 1936 has been nominally $40. The principal use of radium is therapeutic, its chief application being in the treatment of cancer, although radium therapy is employed also for the treatment of sundry dermatological conditions and other diseases. The principal industrial use has been in luminous paints for watch dials, instrument scales, switches, press buttons, signboards, and signals. A more recent development is the use of radium by physical metallurgists for inspecting metal castings for flaws. Radium is much easier to handle than X-rays and is said to give even better results.

*Radium and uranium content of carnotite ores produced in the United States, 1934–38*

| Year | Carnotite ores (short tons) | Radium content (milligrams) | Uranium content (pounds) | Year | Carnotite ores (short tons) | Radium content (milligrams) | Uranium content (pounds) |
|---|---|---|---|---|---|---|---|
| 1934 | 254 | 1,007 | 6,661 | 1937 | 1,708 | 3,141 | 20,764 |
| 1935 | 1,145 | 3,329 | 22,009 | 1938 | 4,290 | 7,821 | 51,705 |
| 1936 | 1,439 | 2,716 | 17,961 | | | | |

Notwithstanding its high price, uranium, mother of radium, is used extensively in ceramics.[20] A stain of sodium uranate, alumina, and silica is used in strongly fired glazes to produce ivory to yellow shades, and in low-fired lead glazes a tomato-red color is obtained by the addition of 15 to 20 percent sodium uranate. Uranium oxide is used in glazed pottery to produce luster or iridescence, coloring the ware greenish yellow, and in glass to yield a wine-yellow color in transmitted light and a greenish-yellow fluorescence in reflected light.

After failing to justify its high price as a ferro-alloying element, uranium is now being added to copper. R. R. Mallory & Co., Inc., Indianapolis, Ind., offers a hard ternary alloy containing copper and uranium which, it is claimed, affords improved performance and

[19] Taft, R. B., Radium Hounds: Sci. American, vol. 160, January 1939, pp. 8, 47.
[20] Harbert, C. J., Less Familiar Elements in Ceramic Pigments: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 7, July 1938, pp. 770–772.

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longer life to current-carrying or heat-carrying members of electrical machinery. Besides its high electric and thermal conductivity, this new alloy is unusually resistant to corrosion by a wide variety of gases and liquids, according to Business Week (December 24, 1938, p. 27).

At the close of 1938 sodium uranate, $Na_2UO_4$, was quoted at $1.75 to $1.80 per pound for either the yellow or orange variety; uranium oxide, 96 percent $U_2O_6$, in 100-pound lots at $2.65 to $2.75 a pound for the black and $1.75 to $1.80 for the yellow or orange product.

## RARE EARTHS

The rare earths continue to command the attention of numerous research workers, although commercial developments are impeded by their high price. Paradoxically, the rare-earth metals are not extremely rare in nature. But they are difficult to separate, and many of their potential uses can be satisfied by cheaper elements. The oxides of cerium are used in ceramics and special glasses. A good résumé of the use of rare earths in the glass industry was published [21] recently, and another paper [22] calls attention to the availability of lanthanum as a byproduct of recovering thoria and ceria from monazite and its potential applications in the ceramic and glass industries, for weighting silk, as a catalyst, and as a constituent of alloys. Ceric oxide is one of the best opacifiers [23] for enamels, yet it is seldom used even in Europe.

Neodymium and praseodymium [24] occur in all cerium minerals in a ratio of at least two parts neodymium to one part praseodymium. Recently neodymium (which stains glass violet) has been applied successfully as a physical decolorizer for glass. Didymium, a mixture of neodymium and praseodymium, gives a neutral-gray glass.

As an illustration of the wide distribution of the rare earths, the Bureau of Chemistry and Soils in cooperation with the National Bureau of Standards has recently identified substantial traces of rare-earth metals in the ashes of many plants. The rare-earth concentrate from hickory leaves grown in a pegmatite vein amounted to 0.2 percent of the dry weight of the leaf.

The Glass Industry (January 1939 issue) quoted cerium hydrate (100-pound drums and 600-pound barrels) at 60 cents a pound, neodymium oxalate (50-pound drums) at $3.50 a pound, and "rare-earth hydrate" at 30 cents (325-pound barrels) to 35 cents (100-pound drums) a pound.

## SELENIUM AND TELLURIUM

More and more selenium is being recovered from copper refining; and, as the use of selenium in glass no longer seems to be increasing, the search for new uses has been resumed. The demand for tellurium is still much less than that for selenium and only a fraction of the quantity that could be recovered if byproduct sources were fully utilized. Tellurium is used to increase the toughness and resistance

[21] Ctyroky, V., Importance of Rare Earths for the Glass Industry: Sklarske Rozhledy, vol. 15, 1938, pp. 23-33; Ceram. Abs., vol. 17, No. 8, August 1938, p. 274.
[22] Arndt, E., and Pütter, K. E., Importance of Lanthanum as a Raw Material: Angew. Chem., vol. 51, 1938, pp. 463-464; Jour. Soc. Chem. Ind., London, vol. 57, No. 9, September 1938; British Chem. Abs., B, p. 1052.
[23] Harbert, C. J., Less Familiar Elements in Ceramic Pigments: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 7, July 1938, pp. 770-772.
[24] Saklatwalla, B. D., Rare Metals and Minerals: Min. and Met., vol. 20, No. 385, January 1939, p. 11.

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to abrasion of rubber hose and cable coverings. Increasing amounts of tellurium lead are being marketed, but this outlet is only a small one, as it takes only a few hundredths of 1 percent of tellurium to harden, toughen, and increase the corrosion resistance of ordinary lead. According to a report of the International Tin Research and Development Council (Pub. 81) tellurium also improves remarkably the work-hardening properties and creep strength of tin; in quantities up to 0.1 percent it improves somewhat the tensile strength and hardness. Industrial hazards from selenium and its toxicity are the subject of a recent Government report.[25] Further research indicates that the bad effects of selenium in soils have been greatly exaggerated.[26] In fact some plants seem to be stimulated by selenium, and a few may actually need it to thrive.[27]

Prices of selenium (black, powdered, 99.5 percent) remained virtually unchanged in 1938 at $1.75 to $1.85 a pound in New York but rose slightly to 7s. 3d. in London. Barium selenide, $BaSeO_3$, is quoted in domestic glass-trade journals at $1.40 to $1.60 a pound, while the quotation for the "commercial" grade (25 percent Se) remains at 85 cents. Sodium selenite, $Na_2SeO_3$, which is also used in glassmaking, is quoted at $1.50 to $1.65 a pound in 1938. New York quotations of $2 a pound for tellurium have remained unchanged for several years, and London trade journals continue to quote the metal at 7s.

*Production, sales, and imports of selenium and production and sales of tellurium in the United States, 1934–38*

| Year | Selenium | | | | Tellurium | |
|---|---|---|---|---|---|---|
| | Production (pounds) | Sales [1] (pounds) | Imports | | Production (pounds) | Sales [1] (pounds) |
| | | | Pounds | Value | | |
| 1934 | 254,394 | 319,838 | 17,719 | $24,591 | 27,214 | 21,027 |
| 1935 | 244,710 | 232,831 | 179,331 | 322,332 | 37,096 | 22,610 |
| 1936 | 352,480 | 226,402 | 122,806 | 215,835 | 57,956 | 25,453 |
| 1937 | 435,821 | 282,598 | 92,523 | 161,382 | 51,409 | 23,365 |
| 1938 | 225,674 | 166,494 | 101,034 | 163,598 | 11,076 | 26,944 |

[1] Bureau of Mines not at liberty to publish value.

## TITANIUM

Because of their great whitening and obliterating power, titanium pigments continue to be employed widely in paint, rubber, linoleum, leather, plastics, soap, printing inks, paper, textiles, and ceramics. In addition to the well-known white pigments an important rich-yellow pigment has recently been developed that contains chromium and antimony as well as titanium dioxide. Ilmenite, used chiefly for making titanium pigments and to a smaller extent for making ferro-alloys, is produced in the United States in Virginia, Arkansas, and California, but the main supply is imported from British India, by far the world's largest producer. Rutile is produced in this country, both for domestic consumption and for export and is also imported

[25] Dudley, H. C., Selenium as a Potential Industrial Hazard: U. S. Public Health Rept. 53, 1938, pp. 281–292.
[26] Lakin, H. W., Williams, K. T., and Byers, H. G., "Nontoxic" Seleniferous Soils: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 5, May 1938, pp. 599–600.
[27] Trelease, Sam, and Helen M., Selenium as a Stimulating and Possibly Essential Element for Certain Plants: Science, vol. 87, No. 2247, 1938, pp. 70–71.



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from Brazil and Australia. Deposits are being opened up in various other countries. The principal uses of rutile are in welding-rod coatings and ceramics; the former recently has become the most important outlet, consuming as much as 1,200 to 2,500 tons a year.[28]

The Bureau of Mines is not at liberty to publish figures of domestic production of ilmenite and rutile. Imports of rutile declined to 130 short tons valued at $26,533 in 1938 compared with 665 tons and a value of $67,643 in 1937. Those of ilmenite continued their phenomenal expansion, reaching 201,545 long tons valued at $1,018,430 compared with the previous record of 153,993 tons valued at $770,757 in 1937.

The rapid growth of the titanium industry and the increasing variety of uses for the element in its sundry products have been reviewed in previous volumes of Minerals Yearbook and are not repeated in this chapter. During 1938 ilmenite was discovered in Natal, payable quantities being reported in sand dredged from Durban Bay. In southern Egypt the Hamata Mining Co., already engaged in mining manganese, installed equipment for producing ilmenite. Rutile, which has been mined sporadically in French Cameroons in Africa, may be mined more systematically following the gradual acquisition of mining rights in the numerous areas. Rutile has been produced extensively in Australia from beach sands at Byron Bay and elsewhere in New South Wales where it occurs with zircon. Deposits of this mineral in South Australia were visited in 1937 by the Government Inspector of Mines, who cautioned against premature expansion of the existing pilot plant which can treat a maximum of 2 tons of crushed ore, equivalent to about 180 pounds of 80 percent concentrate, daily.[29] In South Africa the property in Omaruru that produced over 16 tons of rutile from a high-grade deposit (4 to 20 percent $TiO_2$) was idle in 1938, having been optioned to an overseas firm according to a Government report. The Dominion Bureau of Statistics (Ottawa) reveals a sharp increase in production of titanium ore in Canada to 4,229 short tons valued at $26,432 in 1937, with a drop to 207 tons worth $1, 449 in 1938. The entire output was shipped from St. Urbain, Quebec, to ferro-alloy manufacturers. In France titanium, as well as vanadium and zircon, may be recoverable from "red mud" from bauxite refining.

A new titanium mineral, $FeTiO_3.Fe_3O_4.TiO_2$, is reported [30] from Nellore, India.

Engineering and Mining Journal quotations for titanium ore in 1938 were: Ilmenite, 45 to 55 percent $TiO_2$, f. o. b. Atlantic seaboard, $10 to $12 per gross ton according to grade and impurities; rutile, guaranteed minimum 94 percent concentrate, 10 cents per pound (nominal); 88 to 90 percent, $55 per ton, c. i. f. New York; ferro-carbon-titanium, $142.50 per short ton f. o. b. producer's plant. The price of titanium dioxide was reduced 1 cent at the end of the year to 14 and 14½ cents a pound (carloads). Phthalate-treated pigment was quoted at 22 to 22½ cents per pound with extras for smaller quantities.

[28] Saklatwalla, B. D., Rare Metals and Minerals: Min. and Met., vol. 20, No. 385, January 1939, p. 12.
[29] Imperial Institute (London), South Australian Rutile: Bull., vol. 36, January–March 1938, p. 78.
[30] Jayaraman, N., and Krishnaswami, K. R., Chemical and Mineralogical Study of a New Titanium Mineral from Nellore: Proc. Indian Sci. Cong., 25th Cong., 1938, pt. 3, p. 117; Ceram. Abs., vol. 17, No. 7, July 1938, p. 261.

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## ZIRCONIUM

Australia, India, and Brazil still supply the bulk of the world's zircon, and Brazil is the only source of baddeleyite. Zircon sand is present in concentrates and black sands from California placer-gold mining. It was recovered in commercial quantities for the first time in 1937 in the sluice boxes of the Kaufield dredge, 2 miles east of Lincoln, Placer County, Calif. Exact figures are not available but this appears to be the first domestic production since 1927 when operations at Pablo Beach, Fla., ceased.

The rise to importance of zirconium during the last quarter of a century and the many uses of the metal and its compounds and alloys have been discussed in previous volumes of Minerals Yearbook and are covered more fully in recent papers published by the Foote Mineral Co.[31] An even more comprehensive review appeared in a foreign trade journal.[32]

According to Saklatwalla [33] copper containing 14 to 16 percent zirconium metal yields an alloy comparable to beryllium copper. A new alloy, Silvaz, containing 6 to 6.5 percent zirconium has been developed as a steel refiner. It also contains about 6 percent each aluminum and vanadium and about 40 percent silicon (balance iron). This alloy is claimed to produce better results in refining steel than separate additions of the respective alloys, particularly as to yield and Izod impact ductility. One new use for zircon sand is in the manufacture of molds for cast steel, and another is as an insulator in electric heating devices.

Zirconium metal is used in radio tubes (wire) and rayon spinneret cups (sheet). Zirconium-silicon and zirconium-ferrosilicon alloys are used in steel making, whereas the powdered metal goes into flashlight mixtures and ammunition primers. Even in the aggregate the requirements for such purposes are small, and the bulk of tonnage is in the form of compounds for use in ceramics and welding-rod coatings. The main consumption is in enamel and glaze frits which employ not only zirconium oxide but also zircon and sodium zirconium silicate.

Engineering and Mining Journal quotations during 1938 were nominal: Zircon ore, 55 percent $ZrO_2$, f. o. b. Atlantic seaboard, carload lots, $55; 5-ton lots, $60 per short ton; crude granular zircon, $70 f. o. b. Suspension Bridge, New York, milled, $90.

[31] Meyer, H. C., Economics of Some of the Less Familiar Elements: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 4, April 1938, pp. 431–436.
Fast, J. D., Zirconium: Foote-Prints, vol. 10, Philadelphia, December 1937, pp. 1–24.
Preston, E., Zirconia in Glass: Foote-Prints, vol. 11, Philadelphia, December 1938, pp. 1–11.
[32] Esme, A., Zirconium Compounds and their Application in the Refractory and Ceramic Industries: Argile, No. 178, 1938, pp. 11–15; No. 179, pp. 21–23; No. 181, pp. 18–23. Ceram. Abs., vol. 17, No. 10, October 1938, p. 341.
[33] Saklatwalla, B. D., Rare Metals and Minerals: Min. and Met., vol. 20, No. 385, January 1939, p. 10.

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# PART III. NONMETALS

## BITUMINOUS COAL [1]

By M. E. McMillan, R. L. Anderson, L. N. Plein, F. G. Tryon, and J. W. McBride

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The year 1938 proved to be an eventful one for the coal industry. The sharp drop in the demand for industrial coal resulting from the general recession in business was accentuated by the extraordinarily mild weather that reduced consumption for heating purposes. In addition, competitive fuels continued to make inroads into the diminishing coal market.

A measurable degree of relief was in prospect at the end of the year through the work of the National Bituminous Coal Commission. On February 25 this agency was forced to withdraw the marketing rules and regulations and schedules of minimum prices that it had established late in 1937. During the remainder of the year the Commission proceeded with the task of building a minimum price structure that would comply in detail with requirements of the law. Although

[1] The collection of production statistics of the bituminous-coal industry previously conducted by the Bureau of Mines was transferred to the National Bituminous Coal Commission July 1, 1937. The cooperation of the Coal Commission in contributing this chapter to Minerals Yearbook to maintain the continuity of the bituminous-coal series is gratefully acknowledged.

Data for 1938 are preliminary; detailed statistics with final revisions will be released later. Data for 1937 are final.



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the goal seemed to be in sight at the end of the year no one would venture to predict just when the new prices would be put into effect.

*Production.*—The output of soft coal in 1938 was 344,630,000 tons, a 23-percent drop below 1937. During the first 6 months of 1938 production averaged more than 30 percent below the comparable period of 1937. Although the coal industry made substantial gains along with general business during the latter half of the year, the total output for the year was only 11 percent above the record low of 1932 and 36 percent below the 534,989,000 tons of 1929. (See figs. 1, 2, and 4.)

*Imports and exports.*—Exports of bituminous coal fell from 13,145,000 tons in 1937 to 10,490,000 in 1938, a net drop of 20 percent. At the same time imports, which are relatively insignificant, declined 7 percent from 258,000 tons in 1937 to 241,000 in 1938. As in the past, virtually all these imports and more than 90 percent of the exports resulted from trade with Canada. (See fig. 9.)

*Changes in stocks.*—Over 6 million tons of the coal consumed in 1938 represented net withdrawals from consumer stocks. The

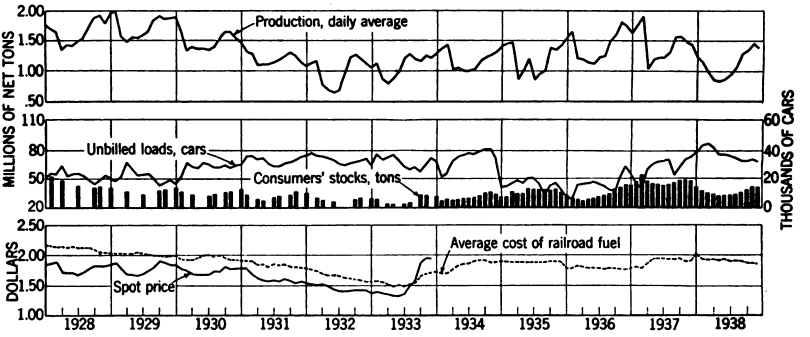


FIGURE 1.—Trends of production, stocks, and prices of bituminous coal, 1928-38.

reserve supply of coal in the hands of industrial consumers and retail coal yards fell from a total of 47,074,000 tons at the beginning of the year to 40,720,000 tons at the close. Between the same periods stocks on the upper Lake docks declined 385,000 tons, and unbilled coal in cars at the mines or classification yards fell 174,000 tons. Although these stocks were consistently lower in 1938 than in 1937, in terms of day's supply they constituted a more adequate reserve, since consumption requirements fell even more sharply than stocks. (See fig. 1 and table 33.)

*Consumption.*—After allowances have been made for foreign trade and changes in consumers' stocks the total consumption of bituminous coal in 1938 amounted to 340,735,000 tons, a decline of 87,762,000 from 1937. Each of the more important classes of consumers shared the reduction, which ranged from 72 percent for beehive coke ovens to 10 percent for electric power utilities. The effect of the decline in industrial consumption was augmented by the weather, since 1938 was one of the warmest years on record. (See fig. 3 and table 4.)

*Distribution.*—Shipments of bituminous coal during 1938 dropped sharply below the 1937 level in each of the primary channels of

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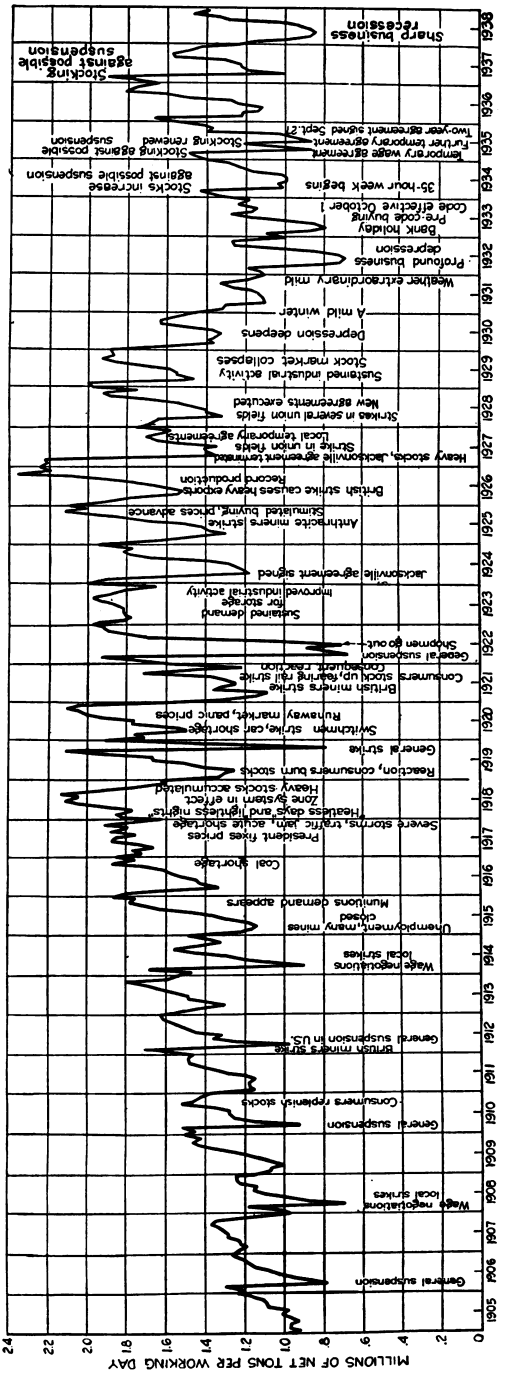


FIGURE 2.—Average production of bituminous coal per working day in each month, 1905–38.

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distribution. Changes in the monthly volume of the more important movements are shown in figure 4.

*Freight rates.*—The average railroad freight charge per net ton of revenue bituminous coal amounted to $2.27 in 1938. The 10-cent-a-

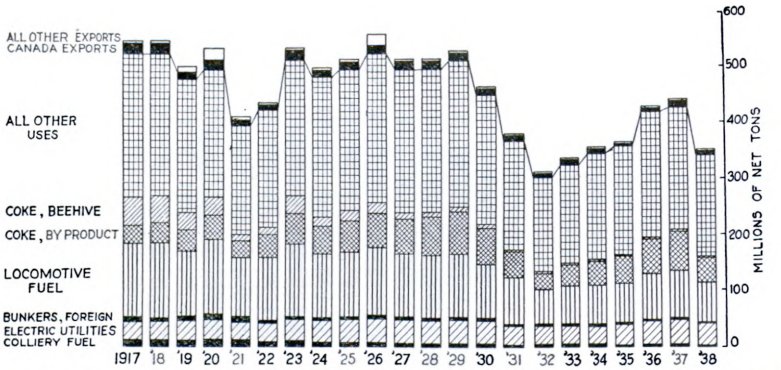


FIGURE 3.—Tonnage of bituminous coal absorbed by the principal branches of consumption, 1917–38.

ton advance over the 1937 average was a result of the new schedule of rates authorized by the Interstate Commerce Commission in Ex Parte 115. The new rates became effective on November 15, 1937, and provided for increases of approximately 9 cents per net ton east

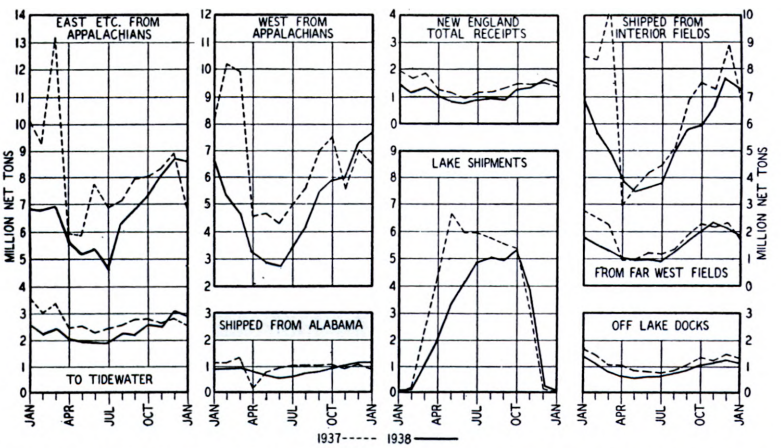


FIGURE 4.—Monthly movement of bituminous coal in the major channels of distribution, 1937–38.

of the Mississippi and 13 cents in the West. The increases ranged from 3 to 10 cents per net ton in eastern territory and from 3 to 15 cents in western, the amount depending on the basic rates.

*Trend of prices.*—During the first 2 months of the year prices of bituminous coal were supported by the schedules of minimum prices

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issued by the National Bituminous Coal Commission. After these prices were withdrawn on February 25 the market quotations slumped sharply. Prices of screenings and slack, which depend very largely on industrial demand, showed the greatest weakness.

Spot market quotations indicate that producers averaged less per ton for their coal in 1938 than in 1937. On the other hand, the Bureau of Labor Statistics series of wholesale prices, f. o. b. destination, show a slight increase for 1938 considering the year as a whole. The divergent movement of these series is explained by the advance of 10 cents a ton between the 2 years in the average cost of transporting bituminous coal by rail. This increase in freight rates more than offsets the reduction in the f. o. b. mine price of coal and raised the delivered price above the 1937 level.

*Mechanization.*—On the basis of data available early in 1939 Coal Age [2] estimated that "25 percent of the deep-mined output was handled by some type of loading equipment." This represents a continuation of the sharp advance in mechanical loading from 16 percent in 1936 to 20 percent in 1937.

Sales of mechanical loading equipment for use in bituminous-coal mines declined in 1938, but at a rate considerably less than the drop in production. Although the output of bituminous coal fell 23 percent the reduction in sales of loading equipment was 17 percent for mobile loaders and only 10 percent for conveyors. Reports from 29 manufacturers show sales of 241 mobile loaders for the current year as against 292 in 1937 and 344 in the peak year of 1936. Conveyor sales totaled 749 in 1938 compared with 835 in 1937 and 682 in 1936.

Details regarding mechanization and equipment in 1938 are given in a supplement to Weekly Coal Report 1127 of the National Bituminous Coal Commission, entitled "Sales of Mechanical Loading Equipment for Use in Coal Mines in 1938," by L. N. Plein, J. J. Gallagher, M. van Siclen, and F. G. Tryon. Summary articles covering the same subject were published in the February 1939 issues of Coal Age and the Mining Congress Journal. (See also fig. 7 and tables 24 and 25.)

*Stripping operations.*—The volume of bituminous coal produced by stripping established a new record in 1937 when 31,750,853 tons were reported—a 13-percent increase over the output in 1936, when stripping operations produced a total of 28,125,857 tons. Although the proportion of strip coal continued to rise in 1938 there was considerable reduction in the total volume produced by this type of operation owing to the general drop in industrial demand.

*Mechanical cleaning.*—Over 61 million tons of bituminous coal were mechanically cleaned in 1936, and preliminary estimates indicate that the amount rose to about 65 million in 1937. Construction of new cleaning plants in 1937 and 1938 added materially to the capacity of the industry to produce mechanically cleaned coal.

*Trend of employment.*—Estimates of the number of men employed at bituminous-coal mines in 1938 indicate a substantial drop from the 1937 figure of 491,864. Indexes compiled by the Bureau of Labor Statistics on the basis of a sample that includes more than half the workers in the industry, show a 12.7-percent drop in employment for

[2] Coal Age, February 1939, p. 28.

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1938. Reports from the mining departments of six States with more than 70 percent of the bituminous-coal employees in the United States indicate an average decline of 10.6 percent for the same period. These data suggest an estimate of 435,000 employees for 1938.

In comparison with 1929, when the average number of men at bituminous-coal mines totaled 502,993, the 1938 figure represents a decrease of 68,000. The number of unemployed coal-mine workers probably exceeded this figure, however, since a considerable number attached to the industry were without jobs, even in 1929. Furthermore, if it had not been for share-the-work agreements the number of unemployed miners in 1938 probably would have been still greater. A partial solution for the unemployment problem, which became exceedingly acute during the depression period, was provided by the industry's reduction of hours for a normal workweek from 48 to 40 and later to 35.

Statistics of employment for bituminous-coal workers cannot be interpreted properly without considering the intermittent operations that characterize most coal mines. In 1937, for instance, the bituminous mines were operated an average of 193 days out of the 261 possible under the 5-day week of the union wage agreement. Consequently, a substantial part of the manpower on the rolls of the industry was idle throughout the year, the number depending on the market and the season.

*Trend of capacity.*—The potential full-time output of active mines in the bituminous-coal industry continued to increase between 1936 and 1937. The coal industry reached its peak capacity in 1923 when, on the basis of 308 operating days, the potential output was 970,000,000 tons. Subsequent liquidations forced the closing or abandonment of thousands of mines and reduced the indicated capacity to 622,000,000 tons in 1934. Increases since 1934 have raised the potential output on a 308-day basis to 710,000,000 tons in 1937.

One of the outstanding developments under the Bituminous Coal Code of the National Industrial Recovery Act was the adoption of a 5-day week for the industry. Under the 5-day week full-time operations are limited to approximately 261 days. The potential capacity of operating mines on a 261-day basis was 601,000,000 tons in 1937 compared with the total actual production of 445,531,449 tons.

*Trend of fuel efficiency.*—Technologic improvements in utilization of fuel since the World War have been responsible for an appreciable reduction in the demand for coal for industrial use. Although the effect tends to be cumulative it should be noted that the changes have been taking place at a much slower rate in recent years. Steam railroads reduced their coal consumption per 1,000 gross ton-miles of freight service from 117 pounds in 1937 to 115 in 1938. Between the same years electric public utility power plants managed to lower the number of pounds of coal per kilowatt-hour from 1.43 to 1.41, and steel companies cut 1.8 percent from the amount of coking coal required to produce a gross ton of pig iron.

It is evident also that savings in fuel are being effected by both domestic consumers and small industrial establishments. Increasing economy in the utilization of fuel, arising from improved heating equipment, has been supplemented by developments in insulation and building construction. Automatic stokers, weather stripping, and

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insulating materials have combined to limit the aggregate demand of domestic and small industrial consumers, who comprise a large segment of the national market.

*Competition of oil and gas.*—Although the consumption of bituminous coal by electric power plants, railroads, and steamships combined dropped 16 percent below the 1937 level the competitive use of fuel oil by the same groups of consumers decreased only 9 percent. At the same time total sales of natural gas also fell 9 percent.

Relative changes in sales of mechanical stokers and oil burners afford a slightly more encouraging picture for the coal industry. Stoker sales declined only 4 percent between 1937 and 1938, while net orders for oil burners dropped 28 percent. In absolute numbers, however, oil-burner sales exceeded mechanical stoker sales by about 50 percent.

*Prospects for 1939.*—The low point of the 1938 recession in the coal market was reached in June. In July the barometers of general business, which had been falling since the autumn of 1937, began to rise again. Although coal prices remained depressed, production continued on the upgrade throughout the remainder of the year. By the end of 1938 the curve of weekly production had overtaken that in the corresponding period of 1937.

The improvement noted has continued into 1939. Consumption has exceeded that in the early months of 1938. Production records up to April 1, when mining operations were suspended in the Appalachian fields, indicate that output during the first quarter of the year was running 23 percent above that for the corresponding period of 1938.

*Statistical tables—1938.*—Tables 1 to 5 give a statistical record of the bituminous-coal industry in 1938, as indicated by available preliminary data. They also show comparative statistics for the indicated earlier years, including final figures for 1937. (See fig. 5.)

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TABLE 1.—*Salient statistics of the bituminous-coal industry, 1937–38*

[All tonnage figures represent net tons]

| | 1937 | 1938 (preliminary) | Change in 1938 |
|---|---|---|---|
| Production | 445,531,449 | 344,630,000 | −22.6% |
| Exports to Canada and Mexico [1] | 12,052,111 | 9,560,717 | −20.7% |
| Exports overseas and all other [1] | 1,092,567 | 929,552 | −14.9% |
| Imports [1] | 257,996 | 241,305 | −6.5% |
| Consumption in the United States (calculated) [2] | 428,496,767 | 340,735,036 | −20.5% |
| Stocks at end of year: | | | |
| Industrial consumers and retail yards | 47,074,000 | 40,720,000 | −13.5% |
| Stocks on upper Lake docks | 8,270,839 | 7,885,516 | −4.7% |
| Unbilled loads, at mines or in classification yards [3] | 1,780,800 | 1,607,200 | −9.7% |
| Price indicators (average per net ton): | | | |
| Average cost of railroad fuel purchased, f. o. b. mines [4] | $1.89 | $1.92 | +3¢ |
| Average cost of coking coal at merchant byproduct ovens [5] | $4.40 | ([6]) | |
| Average cost of bunker coal to vessels in foreign trade [7] | $4.83 | $4.85 | +2¢ |
| Average value of exports to all countries (at port) [8] | $3.71 | $3.63 | −8¢ |
| Average retail price—38 cities [9] | $8.58 | $8.61 | +3¢ |
| Average railroad freight charge per net ton [10] | $2.17 | $2.27 | +10¢ |
| Underground loading machinery sold to bituminous mines: [11] | | | |
| Mobile loading machines (number) | 292 | 241 | −17.5% |
| Scrapers (number) | 13 | 6 | −53.8% |
| Conveyors, including those with duckbills (units) | 835 | 749 | −10.3% |
| Pit-car loaders (units) | 32 | 139 | +334.4% |
| Mechanically loaded, all devices (net tons) | [12] 83,500,000 | ([13]) | |
| Average number of men employed at mines operating [14] | 491,864 | 435,000 | −11.6% |
| Fuel-efficiency indicators: | | | |
| Pounds coal per kw.-hr. at electric power plants [15] | 1.43 | 1.41 | −1.4% |
| Pounds per 1,000 gross ton-miles—railroads [16] | 117 | 115 | −1.7% |

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Production plus imports minus exports plus or minus net changes in consumers' stocks.
[3] Association of American Railroads.
[4] Interstate Commerce Commission. Excludes freight charges.
[5] As reported by coke operators to the Bureau of Mines.
[6] Data not available.
[7] Computed from records of the Bureau of Foreign and Domestic Commerce.
[8] Computed from records of the Bureau of Foreign and Domestic Commerce. The figure represents the average value at the point of export of shipments to all foreign countries including Canada.
[9] Bureau of Labor Statistics.
[10] Average receipts per net ton of revenue bituminous coal originated, as reported by the Interstate Commerce Commission.
[11] Plein, L. N., Gallagher, J. J., van Siclen, M., and Tryon, F. G., Sales of Mechanical Loading Equipment for Use in Coal Mines in 1938: Min. Cong. Jour., February 1939, pp. 40–43; see also Coal Age, February 1939, pp. 56–58.
[12] Preliminary.
[13] Not yet available. Coal Age, February 1939, p. 28, estimated that 25 percent of the deep-mined production was mechanically loaded in 1938.
[14] The figure for 1937 is based on reports of mine operators producing over 1,000 tons. The figure for 1938 is estimated from the employment index of the Bureau of Labor Statistics, which covers about half of the men employed in the industry, and from current monthly reports of 6 State mine departments which represent approximately 70 percent of all the bituminous-coal-mine workers in the United States.
[15] Federal Power Commission.
[16] Interstate Commerce Commission, includes coal equivalent of fuel oil consumed.

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TABLE 2.—*Salient trends in bituminous mine operation, 1913–37*

| | 1913 | 1923 | 1929 | 1932 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|---|---|---|
| Production: | | | | | | | | |
| Loaded at mines for shipment by rail, net tons | 392,743,412 | 488,974,496 | 474,868,165 | 276,142,037 | 313,303,729 | 319,741,376 | 370,762,901 | 399,237,575 |
| Loaded at mines for shipment by water, do | 10,690,834 | 16,884,799 | 23,066,289 | 9,365,782 | 15,127,968 | 18,327,282 | 24,867,683 | |
| Made into coke at mines, do | 49,458,320 | 27,859,316 | 9,128,607 | 1,028,458 | 1,647,805 | 1,467,902 | 2,728,577 | 4,884,054 |
| Used at mines for colliery fuel, do | 11,670,903 | 8,765,011 | 4,662,974 | 2,780,889 | 3,175,057 | 3,102,691 | 3,227,447 | 3,052,095 |
| Commercial sales by truck or wagon, do | 13,871,828 | 22,081,040 | 23,262,558 | 20,392,706 | [1] 18,739,320 | 21,960,252 | 27,929,298 | 37,762,612 |
| Other local sales, used by employees, etc, do | | | | | 7,374,143 | 7,773,619 | 9,571,997 | |
| Total production, do | 478,435,297 | 564,564,662 | 534,988,593 | 309,709,872 | 359,368,022 | 372,373,122 | 439,087,903 | [2] 445,531,449 |
| Number of active mines of commercial size: | | | | | | | | |
| Class 1 (200,000 tons or more), number | 694 | 748 | 827 | 465 | 551 | 561 | 660 | 661 |
| Class 2 (100,000 to 200,000 tons), do | 837 | 935 | 660 | 477 | 485 | 479 | 452 | 469 |
| Class 3 (50,000 to 100,000 tons), do | 959 | 1,176 | 668 | 469 | 479 | 503 | 460 | 448 |
| Class 4 (10,000 to 50,000 tons), do | 1,558 | 2,742 | 1,361 | 1,111 | 1,072 | 1,056 | 1,085 | 1,117 |
| Class 5 (1,000 to 10,000 tons), do | 1,728 | 3,730 | 2,541 | 2,905 | 3,671 | 3,716 | 4,218 | 3,853 |
| Total number over 1,000 tons, do | 5,776 | 9,331 | 6,057 | 5,427 | [3] 6,258 | [3] 6,315 | [3] 6,875 | [3] 6,548 |
| Percent of output from mines in classes 1 and 2, percent | 75.4 | 70.4 | 83.1 | 77.5 | 80.5 | 80.7 | 83.8 | 84.1 |
| Average number of men employed at mines active: | | | | | | | | |
| Underground, men | 494,238 | 600,305 | 433,999 | 345,905 | 384,947 | 389,942 | 399,367 | [4] |
| Surface, including strip pits, do | 77,644 | 104,488 | 68,994 | 60,475 | 73,064 | 72,461 | 77,837 | [4] |
| Total, do | 571,882 | 704,793 | 502,993 | 406,380 | 458,011 | 462,403 | 477,204 | 491,864 |
| Average number of days mines operated, days | 232 | 179 | 219 | 146 | 178 | 179 | 199 | 193 |
| Nominal length of established full-time week [5], hours | 51.6 | 48.4 | 48.5 | 48.6 | 40.0 and 35.1 | 35.1 | 35.1 | 35.1 |
| Capacity of active mines with existing labor force: | | | | | | | | |
| Per year of 308 days (full time before October 1933), net tons | 635,000,000 | 970,000,000 | 752,000,000 | 653,000,000 | 622,000,000 | 640,000,000 | 680,000,000 | 710,000,000 |
| Per year of 261 days (5-day week basis), do | 538,000,000 | 823,000,000 | 638,000,000 | 554,000,000 | 527,000,000 | 543,000,000 | 576,000,000 | 601,000,000 |
| Output per man per day [6], do | 3.61 | 4.47 | 4.85 | 5.22 | 4.40 | 4.50 | 4.62 | 4.69 |
| Output per man per year, do | 837 | 801 | 1,064 | 762 | 785 | 805 | 920 | 906 |
| Underground output cut by machine, percent | 50.7 | 68.3 | 78.4 | 84.1 | 84.1 | 84.2 | 84.8 | [4] |
| Underground output mechanically loaded, do | | 0.3 | 7.4 | 12.6 | 12.2 | 13.5 | 16.3 | 20.2 |
| Quantity mined by stripping, net tons | [7] 1,280,946 | 11,940,134 | 20,268,099 | 19,641,128 | 20,789,641 | 23,647,292 | 28,125,857 | 31,750,853 |
| Quantity cleaned by wet or pneumatic processes [8], do | 22,069,691 | 20,140,385 | 32,271,950 | 27,357,599 | 35,853,714 | 39,511,176 | 53,332,040 | [4] |

[1] The earliest year in which figures were collected in strictly comparable form was 1933, when commercial sales by truck and wagon were 15,462,739 tons.
[2] The total production differs from the sum of the items shown by the amount of the changes in inventory and of tonnage not accounted for in the distribution analysis.
[3] The increase in number of mines shown for 1934–37 over preceding years is due partly to more complete coverage of small trucking mines (producing over 1,000 tons a year). See Minerals Yearbook, 1936, pp. 561–564.
[4] Data not available.
[5] The figures represent the full-time week as reported by the operator, not the hours actually worked by the men.
[6] Affected by changes in length of working day.
[7] Figures for 1914, the year of earliest record.
[8] Exclusive of central washeries operated by consumers.

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TABLE 3.—*Preliminary statistics of coal production in 1938, by States, with final figures for earlier years*

| State | Production in thousands of net tons | | | | | | | | Percent change, 1937–38 | Percent of total bituminous | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1913 | 1923 | 1929 | 1932 | 1935 | 1936 | 1937 | 1938 pre. | | 1913 | 1923 | 1929 | 1932 | 1935 | 1936 | 1937 | 1938 pre. |
| Alaska | 2 | 120 | 101 | 103 | 119 | 137 | 132 | 137 | +3.7 | (1) | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 |
| Alabama | 17,678 | 20,458 | 17,944 | 7,857 | 8,505 | 12,229 | 12,440 | 10,950 | −12.0 | 3.69 | 3.62 | 3.35 | 2.54 | 2.29 | 2.78 | 2.79 | 3.18 |
| Arkansas | 2,234 | 1,297 | 1,695 | 1,033 | 1,133 | 1,623 | 1,511 | 1,192 | −21.1 | .47 | .23 | .32 | .33 | .30 | .37 | .34 | .35 |
| Oklahoma | 4,166 | 2,885 | 3,774 | 1,255 | 1,229 | 1,540 | 1,600 | 1,269 | −20.7 | .87 | .51 | .71 | .41 | .33 | .35 | .36 | .37 |
| Colorado | 9,232 | 10,346 | 9,921 | 5,599 | 5,911 | 6,812 | 7,187 | 5,676 | −21.0 | 1.93 | 1.83 | 1.85 | 1.81 | 1.59 | 1.55 | 1.61 | 1.65 |
| Georgia | 256 | 76 | 45 | 27 | 23 | 24 | (2) | 26 | ------ | .05 | .01 | .01 | .01 | .01 | .01 | (2) | .01 |
| North Carolina | | 36 | 52 | 2 | | | | | | | .01 | .01 | | | | | |
| Illinois | 61,619 | 79,310 | 60,658 | 33,475 | 44,525 | 50,927 | 51,602 | 40,650 | −21.2 | 12.88 | 14.05 | 11.34 | 10.81 | 11.96 | 11.60 | 11.58 | 11.79 |
| Indiana | 17,166 | 26,229 | 18,344 | 13,324 | 15,754 | 17,822 | 17,765 | 14,050 | −20.9 | 3.59 | 4.65 | 3.43 | 4.30 | 4.23 | 4.06 | 3.99 | 4.08 |
| Iowa | 7,526 | 5,711 | 4,241 | 3,862 | 3,650 | 3,961 | 3,637 | 3,250 | −10.6 | 1.57 | 1.01 | .79 | 1.25 | .98 | .90 | .82 | .94 |
| Kansas | 7,202 | 4,443 | 2,976 | 1,953 | 2,686 | 2,944 | 2,893 | 2,560 | −11.5 | 1.51 | .79 | .56 | .63 | .72 | .67 | .65 | .74 |
| Missouri | 4,318 | 3,403 | 4,030 | 4,070 | 3,646 | 3,985 | 4,091 | 3,412 | −16.6 | .90 | .60 | .75 | 1.31 | .98 | .91 | .92 | .99 |
| Kentucky: | | | | | | | | | | | | | | | | | |
| Eastern | 11,099 | 33,887 | 46,025 | 25,760 | 32,627 | 39,152 | 38,523 | 31,096 | −19.3 | 2.32 | 6.00 | 8.60 | 8.32 | 8.76 | 8.92 | 8.65 | 9.02 |
| Western | 8,518 | 10,890 | 14,437 | 9,540 | 8,134 | 8,370 | 8,563 | 7,400 | −13.6 | 1.78 | 1.93 | 2.70 | 3.08 | 2.18 | 1.91 | 1.92 | 2.15 |
| Maryland | 4,780 | 2,286 | 2,649 | 1,429 | 1,678 | 1,704 | 1,549 | 1,306 | −15.7 | 1.00 | .40 | .50 | .46 | .45 | .39 | .35 | .38 |
| Michigan | 1,232 | 1,172 | 805 | 446 | 628 | 626 | 562 | 478 | −14.9 | .26 | .21 | .15 | .14 | .17 | .14 | .13 | .14 |
| Montana [3] | 3,241 | 3,148 | 3,408 | 2,125 | 2,759 | 2,988 | 2,965 | 2,804 | −5.4 | .68 | .56 | .64 | .69 | .74 | .68 | .67 | .81 |
| New Mexico | 3,709 | 2,915 | 2,623 | 1,263 | 1,389 | 1,597 | 1,715 | 1,252 | −27.0 | .78 | .52 | .49 | .41 | .37 | .36 | .38 | .36 |
| North Dakota [3] | 495 | 1,386 | 1,862 | 1,740 | 1,956 | 2,215 | 2,251 | 2,047 | −9.1 | .10 | .25 | .35 | .56 | .52 | .50 | .50 | .59 |
| South Dakota [3] | 11 | 11 | 13 | 49 | 13 | 41 | 47 | 48 | +2.1 | (1) | (1) | (1) | .02 | (1) | .01 | .01 | .01 |
| Ohio | 36,200 | 40,546 | 23,689 | 13,909 | 21,153 | 24,110 | 25,178 | 17,920 | −28.8 | 7.57 | 7.18 | 4.43 | 4.49 | 5.68 | 5.49 | 5.65 | 5.20 |
| Pennsylvania (bituminous) | 173,781 | 171,880 | 143,516 | 74,776 | 91,405 | 109,887 | 111,002 | 77,040 | −30.6 | 36.32 | 30.45 | 26.83 | 24.14 | 24.55 | 25.03 | 24.91 | 22.35 |
| Tennessee | 6,860 | 6,040 | 5,406 | 3,538 | 4,138 | 5,108 | 5,213 | 4,373 | −16.1 | 1.43 | 1.07 | 1.01 | 1.14 | 1.11 | 1.16 | 1.17 | 1.27 |
| Texas [3] | 2,429 | 1,137 | 1,101 | 637 | 758 | 843 | 910 | 892 | −2.0 | .51 | .21 | .20 | .21 | .20 | .19 | .20 | .26 |
| Utah | 3,255 | 4,720 | 5,161 | 2,852 | 2,947 | 3,247 | 3,810 | 2,908 | −23.7 | .68 | .84 | .97 | .92 | .79 | .74 | .85 | .84 |
| Virginia | 8,828 | 11,762 | 12,748 | 7,692 | 9,667 | 11,662 | 13,795 | 12,192 | −11.6 | 1.85 | 2.08 | 2.38 | 2.48 | 2.60 | 2.66 | 3.10 | 3.54 |
| Washington | 3,878 | 2,926 | 2,521 | 1,591 | 1,559 | 1,812 | 2,002 | 1,565 | −21.8 | .81 | .52 | .47 | .51 | .42 | .41 | .45 | .46 |
| West Virginia | 71,254 | 107,900 | 138,519 | 85,609 | 99,179 | 117,926 | 118,646 | 92,922 | −21.7 | 14.89 | 19.11 | 25.89 | 27.64 | 26.64 | 26.86 | 26.63 | 26.96 |
| Wyoming | 7,393 | 7,575 | 6,705 | 4,171 | 5,177 | 5,781 | 5,918 | 5,200 | −12.1 | 1.55 | 1.34 | 1.25 | 1.35 | 1.39 | 1.32 | 1.33 | 1.51 |
| Other States [4] | 73 | 20 | 20 | 23 | 25 | 15 | 24 | 15 | ------ | .01 | (1) | (1) | .01 | .01 | (1) | .01 | .01 |
| Total bituminous | 478,435 | 564,565 | 534,989 | 309,710 | 372,373 | 439,088 | 445,531 | 344,630 | −22.6 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Pennsylvania anthracite | 91,525 | 93,339 | 73,828 | 49,855 | 52,159 | 54,580 | 51,856 | 46,099 | −11.1 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| Grand total | 569,960 | 657,904 | 608,817 | 359,565 | 424,532 | 493,668 | 497,387 | 390,729 | −21.4 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ |

[1] Less than 0.01.
[2] Included in "Other States."
[3] Lignite figures from Bureau of Mines.
[4] Includes Arizona, California, Georgia, Nebraska, Nevada, and Oregon. The States reporting are not identical from year to year.

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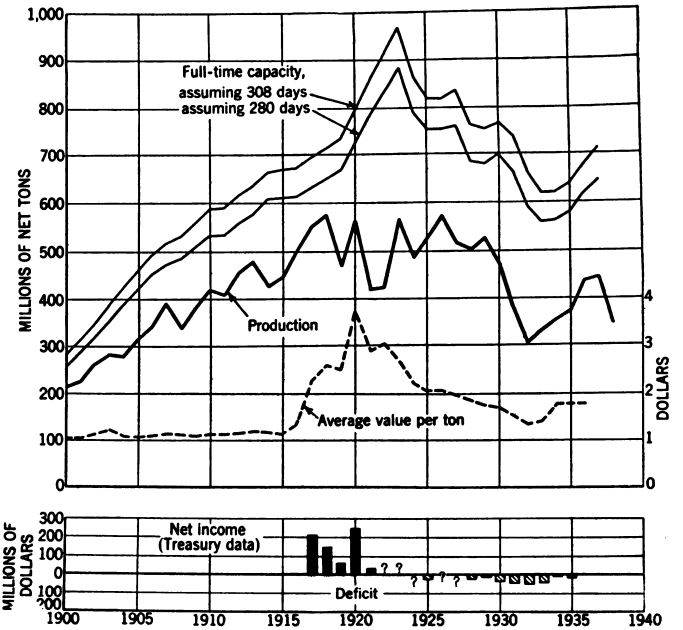


FIGURE 5.—Trends of bituminous-coal production, realization, mine capacity, and net income or deficit in the United States, 1900–1938.

TABLE 4.—*Changes in the United States consumption of bituminous coal by such classes of consumers as report currently, and by all other consumers, 1929 and 1934–38, in thousands of net tons* [1]

[Information on several other classes of consumers is available for certain years. The items shown in this table are selected because they are available in strictly comparable form for each year]

| Year | Consumed in the United States | | | | | | | | Exported | | Total of consumption and exports [8] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Colliery fuel | Electric power utilities [2] | Bunkers, foreign trade [3] | Locomotive fuel, class I roads [4] | Coke [5] | | All other uses [6] | Total consumption [7] | To Canada and Mexico | To other countries (seaborne) | |
| | | | | | Beehive ovens | By-product ovens | | | | | |
| 1929 | 4,663 | 44,937 | 4,287 | 113,894 | 10,028 | 76,759 | 264,987 | 519,555 | 14,727 | 2,702 | 536,984 |
| 1934 | 3,175 | 33,555 | 1,321 | 70,496 | 1,635 | 44,343 | 192,518 | 347,043 | 10,213 | 656 | 357,912 |
| 1935 | 3,103 | 34,807 | 1,576 | 71,335 | 1,469 | 49,046 | 198,956 | 360,292 | 9,044 | 698 | 370,034 |
| 1936 | 3,227 | 42,025 | 1,622 | 81,130 | 2,698 | 63,244 | 228,850 | 422,796 | 9,912 | 743 | 433,451 |
| 1937 | 3,052 | 44,766 | 1,832 | 82,667 | 4,927 | 69,575 | 221,678 | 428,497 | 12,052 | 1,093 | 441,642 |
| 1938 [9] | 2,361 | 40,212 | 1,352 | 69,675 | 1,360 | 44,993 | 180,782 | 340,735 | 9,561 | 930 | 351,226 |

[1] Comparable data for other earlier years in Minerals Yearbook, 1937, p. 799.
[2] Geological Survey and Federal Power Commission. Represents all coal consumed by public utility power plants in power generation, including a small amount of anthracite.
[3] Bureau of Foreign and Domestic Commerce.
[4] Interstate Commerce Commission. Represents bituminous coal consumed as locomotive fuel by class I steam railways, excluding switching and terminal companies.
[5] Bureau of Mines.
[6] Obtained by subtracting the known items from the calculated total consumption. Includes general manufacturing, domestic, and many miscellaneous uses.
[7] Production plus imports minus exports, plus or minus changes in consumers' stocks.
[8] Includes imports.
[9] Subject to revision.

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TABLE 5.—*Trends in distribution of bituminous coal, 1923, 1929, and 1937–38*

[For details and sources of data ,see Monthly Report on Distribution of Coal Shipments; tonnage figure shown in thousands of net tons]

| | 1923 | | 1929 | | 1937 | | 1938 preliminary | |
|---|---|---|---|---|---|---|---|---|
| | Net tons | Percent | Net tons | Percent | Net tons | Percent | Net tons | Percent |
| New England receipts: | | | | | | | | |
| Via rail across the Hudson | 9,634 | 41.9 | 6,781 | 31.9 | 4,885 | 27.5 | 4,104 | 29.2 |
| Via tidewater from Northern ports | 3,703 | 16.1 | 1,570 | 7.4 | 364 | 2.0 | 125 | .9 |
| Via tidewater from Southern ports | 9,671 | 42.0 | 12,875 | 60.7 | 12,553 | 70.5 | 9,808 | 69.9 |
| Total New England | 23,008 | 100.0 | 21,226 | 100.0 | 17,802 | 100.0 | 14,037 | 100.0 |
| Tidewater loadings: | | | | | | | | |
| By ports: | | | | | | | | |
| At New York and Philadelphia | 14,693 | 39.2 | 12,226 | 32.1 | 9,683 | 29.2 | 8,565 | 31.1 |
| At Baltimore, Hampton Roads, and Charleston | 22,828 | 60.8 | 25,825 | 67.9 | 23,467 | 70.8 | 19,018 | 68.9 |
| Total | 37,521 | 100.0 | 38,051 | 100.0 | 33,150 | 100.0 | 27,583 | 100.0 |
| By fields of origin: | | | | | | | | |
| From Pennsylvania and northern West Virginia | 19,760 | 52.7 | 15,516 | 40.8 | 11,859 | 35.8 | 10,394 | 37.7 |
| From southern low-volatile fields | 13,619 | 36.3 | 17,103 | 44.9 | 16,180 | 48.8 | 13,274 | 48.1 |
| From southern high-volatile fields | 4,142 | 11.0 | 5,432 | 14.3 | 5,111 | 15.4 | 3,915 | 14.2 |
| Total | 37,521 | 100.0 | 38,051 | 100.0 | 33,150 | 100.0 | 27,583 | 100.0 |
| By destination: | | | | | | | | |
| To New England | 13,374 | 35.6 | 14,445 | 38.0 | 12,916 | 39.0 | 9,933 | 36.0 |
| Foreign | 5,122 | 13.7 | 2,852 | 7.5 | 1,249 | 3.8 | 1,029 | 3.7 |
| Bunkers | 5,442 | 14.5 | 5,507 | 14.5 | 1,758 | 5.3 | 1,280 | 4.7 |
| Inside capes and other tonnage | 13,583 | 36.2 | 15,247 | 40.0 | 17,227 | 51.9 | 15,341 | 55.6 |
| Total | 37,521 | 100.0 | 38,051 | 100.0 | 33,150 | 100.0 | 27,583 | 100.0 |
| Lake Erie loadings: | | | | | | | | |
| By fields of origin (cargo and fuel): | | | | | | | | |
| From Ohio | 6,417 | 20.9 | 3,734 | 9.5 | 3,231 | 7.1 | 2,390 | 6.8 |
| From Pittsburgh and other Pennsylvania | 9,980 | 32.4 | 8,586 | 21.8 | 11,763 | 26.0 | 8,019 | 22.8 |
| From Moundsville, Fairmont, Cumberland-Piedmont | 3,277 | 10.7 | 2,184 | 5.5 | 2,319 | 5.1 | 1,389 | 4.0 |
| From southern West Virginia, high volatile | 4,994 | 16.2 | 10,233 | 26.0 | 10,975 | 24.3 | 8,329 | 23.7 |
| From southern West Virginia, low volatile | 2,871 | 9.3 | 7,656 | 19.4 | 8,428 | 18.6 | 7,612 | 21.7 |
| From east Kentucky, Tennessee, and Virginia | 3,229 | 10.5 | 6,991 | 17.8 | 8,530 | 18.9 | 7,392 | 21.0 |
| Total | 30,768 | 100.0 | 39,384 | 100.0 | 45,246 | 100.0 | 35,131 | 100.0 |
| By destinations (cargo only): | | | | | | | | |
| To American points | 24,172 | 81.5 | 31,943 | 84.2 | 35,123 | 80.6 | 27,656 | 80.9 |
| To Canadian points | 5,475 | 18.5 | 6,007 | 15.8 | 8,479 | 19.4 | 6,510 | 19.1 |
| Total | 29,647 | 100.0 | 37,950 | 100.0 | 43,602 | 100.0 | 34,166 | 100.0 |
| Across Lake Michigan car ferry | 1,373 | ------ | 1,282 | ------ | 650 | ------ | 588 | ------ |
| West-bound rail to Mississippi Valley: (Revenue all-rail shipments excluding railroad fuel, Lake coal, and movement to Kentucky points) | | | | | | | | |
| From Ohio fields | 22,970 | 14.7 | 12,912 | 7.8 | 11,861 | 9.5 | 8,042 | 8.7 |
| From Pennsylvania fields | 15,853 | 10.1 | 21,885 | 13.3 | 15,091 | 12.1 | 9,620 | 10.4 |
| From northern West Virginia and Cumberland-Piedmont | 2,509 | 1.6 | 5,464 | 3.3 | 3,521 | 2.8 | 2,615 | 2.8 |
| From southern West Virginia, high volatile | 17,525 | 11.2 | 25,148 | 15.3 | 17,293 | 13.9 | 13,668 | 14.8 |
| From southern West Virginia, low volatile | 13,535 | 8.6 | 23,691 | 14.4 | 19,575 | 15.8 | 13,335 | 14.5 |
| From east Kentucky, Tennessee, and Virginia | 17,789 | 11.3 | 24,057 | 14.6 | 17,953 | 14.5 | 14,120 | 15.3 |
| Total from Appalachian fields | 90,181 | 57.5 | 113,157 | 68.7 | 85,294 | 68.6 | 61,400 | 66.5 |
| From Illinois | 48,401 | 30.9 | 34,863 | 21.2 | 26,625 | 21.4 | 20,719 | 22.5 |
| From Indiana | 14,549 | 9.3 | 10,589 | 6.4 | 10,594 | 8.5 | 8,501 | 9.2 |
| From west Kentucky [1] | 3,569 | 2.3 | 6,175 | 3.7 | 1,859 | 1.5 | 1,661 | 1.8 |
| Total from Middle West fields | 66,519 | 42.5 | 51,627 | 31.3 | 39,078 | 31.4 | 30,881 | 33.5 |
| Grand total | 156,700 | 100.0 | 164,784 | 100.0 | 124,372 | 100.0 | 92,281 | 100.0 |

[1] The figures for west Kentucky cover in recent years a much smaller percentage of the field's production than do those for Illinois and Indiana, and may not be fully comparable with earlier years.

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TABLE 5.—*Trends in distribution of bituminous coal, 1923, 1929, and 1937–38*—Continued

| | 1923 | | 1929 | | 1937 | | 1938 preliminary | |
|---|---|---|---|---|---|---|---|---|
| | Net tons | Percent | Net tons | Percent | Net tons | Percent | Net tons | Percent |
| Total shipments from other groups: (All shipments including in this case non-revenue railroad fuel): [2] | | | | | | | | |
| From Michigan fields | 1,086 | [3] 0.2 | 745 | [3] 0.1 | 181 | ([3] [4]) | 150 | ([3] [4]) |
| From upper Lake commercial docks, all deliveries | ([5]) | ------ | 16,689 | [3] 3.1 | 13,518 | [3] 3.1 | 10,845 | [3] 3.2 |
| From Iowa, Missouri, Kansas | 12,222 | [3] 2.2 | 9,488 | [3] 1.8 | 7,202 | [3] 1.6 | 6,273 | [3] 1.8 |
| From Arkansas, Oklahoma, Texas | 5,125 | [3] .9 | 6,337 | [3] 1.2 | 3,739 | [3] .8 | 3,173 | [3] .9 |
| From far western fields | 30,286 | [3] 5.4 | 29,705 | [3] 5.6 | 21,867 | [3] 4.9 | 17,759 | [3] 5.2 |
| From Alabama field | 19,569 | [3] 3.5 | 17,503 | [3] 3.3 | 11,771 | [3] 2.7 | 10,177 | [3] 3.0 |

[2] Excluding commercial sales by truck and wagon, except from upper Lake docks.
[3] Percent of total national shipments from all mines, all destinations.
[4] Less than 0.05 percent.
[5] Data not available.

## SOURCES OF DATA AND ACKNOWLEDGMENTS

Bituminous-coal production statistics for 1938 are preliminary estimates based on (1) weekly or monthly reports of railroad carloadings of coal and beehive coke by all the important carriers, (2) shipments by river as reported by the United States Army Engineers, (3) direct reports from a number of mining companies, (4) monthly production statements compiled by various local operators' associations, including the following: Central Pennsylvania Coal Producers Association, Georges Creek and Upper Potomac Coal Association, Coal Trade Association of Indiana, Hazard Coal Operators Association, Kanawha Coal Operators Association, Eastern Ohio Operators Association, North Dakota Board of Railroad Commissioners, Utah Coal Operators Association, Virginia Operators Association, West Kentucky Coal Bureau, Winding Gulf Operators Association, and Operators Association of the Williamson Field. Especial acknowledgment for detailed monthly production reports is made to: Thomas Allen, Colorado inspector of coal mines; James McSherry, director, Illinois Department of Mines and Minerals; the late M. J. Hartneady and his successor, J. I. Thomas, secretary, Pennsylvania Department of Mines; N. P. Rhinehart, chief, West Virginia Department of Mines; J. E. Bergin, chief inspector, Washington Department of Mines.

In the estimates for 1938 allowance has been made for commercial truck shipments, local sales and colliery fuel, and small trucking or wagon mines producing over 1,000 tons a year. Production of mines on the border between two States has been credited to the State from which the coal is extracted rather than that in which the tipple is situated. If the coal is mined from lands in both States the tonnage has been apportioned accordingly.

The data in this report on the output of bituminous coal in 1936 and earlier years are based on detailed annual reports of production and mine operation courteously furnished by the producers. These reports depended on the voluntary cooperation of the producing companies. The system of voluntary reporting has been in use since 1883, when these statistics were inaugurated by the Geological Survey,



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and has served a useful purpose in the measurement of production, supply and demand, trends of employment, mechanical equipment, operating practices, and output per man.

A combination of circumstances made it advisable for the National Bituminous Coal Commission to modify the method of compilation for 1937. On April 13, 1938, the Commission issued its Order 239, requiring all producers of bituminous coal to return a detailed accounting of the distribution of the entire production of each mine in 1937. Mines with rail or river connections were instructed to report their distribution on Commission form D–1. The form called for a statement of the tons of each individual size of coal shipped to each destination town. Mines selling only by truck reported on a simplified form known as D–2, which was adapted to their operations. This analysis of distribution was an essential prerequisite to the establishment of minimum prices under the coal act and was recognized as perhaps the most extensive task of fact-finding undertaken in the history of the bituminous-coal industry. The producers responded generously to the Commission's order, and the record of distribution developed from rail-connected mines to each ultimate destination is substantially complete.

Because of the size of the task and the great detail covered by the distribution analysis it was deemed inadvisable to require producers to prepare a separate report on production and mine operation. The items of tonnage produced had been covered on the distribution questionnaires in exceptional detail and had been rendered in each instance under affidavit of the producing company. It was therefore decided to utilize the tonnage statistics on forms D–1 and D–2 as the record of production for the year and to compile a record of employment, working time, and mechanical equipment by drawing upon the reports furnished by mine operators to the State inspection services. Nearly all of the coal-mining States require annual statistics to be filed with the local department of mines. In the few States that maintain no statistical record, other sources of information have been available. These reports, made available to the Commission in all necessary detail, have been used to assemble statistics on men employed, days operated, and tonnages produced by strip and underground mining for each coal-mining county in a form reasonably comparable with the Federal enumeration of previous years.

The aggregates and averages of men employed and working time derived in this way may differ from the corresponding figures published in the State reports for two reasons. First, the primary basis of the compilation is the tonnage record of each mine reported to the Coal Commission, against which has been matched the employment and operating record reported to the State. Although the two sources have been carefully checked for discrepancies there are differences in assignment of individual mines to districts and in the minimum size limit covered by the State and Federal enumerations that introduce discrepancies in the resulting totals. Second, the State data have in each instance been handled in a uniform manner, each step in the process of tabulating, editing, and summarizing the primary materials being taken with a view to rendering the final product as comparable as possible with the Federal series for the earlier years. Inasmuch as widely differing methods of analysis are used by the several States the uniform method followed by the authors may yield differing results.

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Despite the effort at uniformity of treatment the statistician will realize that differences in the primary questionnaires used by the various States may impair the strict comparability of the employment record. The principal points of difference are discussed in the section dealing with labor statistics. Beginning with 1938 the Commission will resume collection of material for a direct report on employment, operating time, production, and mechanical equipment of the mines.

In the present chapter attention is centered on the detailed breakdown of tonnage produced according to method of shipment, which the distribution survey has made possible. For the first time figures are now available showing for each producing county the tonnage shipped to tidewater and the Great Lakes, the river movement, and the all-rail movement, the latter segregated between railroad fuel and commercial business. (See tables 6 and 39.)

Acknowledgment is made to the many individuals and agencies both public and private who have cooperated generously in making the survey possible.

## FINAL BITUMINOUS STATISTICS FOR 1936 AND 1937

Tables 6 to 13, 16, 18, 24, 25, and 32–42 give the final detailed statistics of bituminous mine operations in 1937. The subjects covered include production, number and size of mines, employment, equipment and methods of preparation, fuel economy, stocks, foreign trade, and world production. Statistics for 1938, where available, have been included in these tables.

Tables 14, 15, 17, 19–23, and 26–31 relate to 1936 and show data on mechanical loading, mechanical cleaning, stripping operations, and power drilling that were not included in the detailed report for 1936 owing to space limitations.

In accordance with the practice followed by the Bureau of Mines in previous years the statistics in this report relate to mines having an output of 1,000 tons a year or more and do not attempt to include the many small mines producing less than 1,000 tons per year that sell their output by wagon or truck.

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# PRODUCTION

## SUMMARY BY STATES

TABLE 6.—*Summary of coal produced, men employed, days operated, and output per man per day in 1937, by States*

[Exclusive of product of truck and wagon mines producing less than 1,000 tons]

| State | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines [3] | Total production including inventory change and coal unaccounted for [4] | | | |
| | To tide water | To Great Lakes | River and ex-river | All-rail other than railroad fuel [1] | Railroad fuel, all-rail [2] | Total | | | | | | | |
| Alabama | 350,924 | | 81,291 | 8,045,912 | 3,282,094 | 11,760,221 | 499,903 | 86,853 | 112,007 | 12,440,322 | 22,613 | 200 | 2.74 |
| Alaska | | | | 93,144 | 35,464 | 128,608 | | 4 | 3,251 | 131,657 | 123 | 207 | 5.16 |
| Arkansas | | | | 1,343,688 | 121,780 | 1,465,468 | 33,376 | 1,524 | 8,776 | 1,510,753 | 4,253 | 136 | 2.61 |
| Colorado | | | | 3,868,313 | 1,470,179 | 5,338,492 | 1,555,973 | 49,827 | [2] 260,350 | 7,187,211 | 9,432 | 181 | 4.21 |
| Illinois | | | 85,633 | 27,179,245 | 15,559,796 | 42,824,674 | 7,610,873 | 203,317 | 758,386 | 51,601,638 | 42,449 | 168 | 7.25 |
| Indiana | | | | 10,111,205 | 5,435,093 | 15,546,298 | 1,986,271 | 28,046 | 194,666 | 17,764,774 | 11,238 | 174 | 9.10 |
| Iowa | | | | 1,001,540 | 729,633 | 1,731,173 | 1,833,005 | 45,237 | 25,922 | 3,637,054 | 8,720 | 146 | 2.87 |
| Kansas | | | | 1,716,951 | 803,215 | 2,520,166 | 350,820 | 6,110 | 15,769 | 2,892,560 | 3,574 | 173 | 4.68 |
| Kentucky | 475,959 | 9,169,080 | 245,928 | 28,963,202 | 6,362,517 | 45,216,686 | 1,304,459 | 251,759 | 203,887 | 47,086,444 | 55,596 | 192 | 4.41 |
| Maryland | 132,865 | | | 942,910 | 207,350 | 1,283,125 | 272,393 | 6,799 | 8,555 | 1,548,980 | 2,525 | 189 | 3.25 |
| Michigan | | | | 137,519 | 43,450 | 180,969 | 342,857 | 8,673 | 24,435 | 562,262 | 1,343 | 145 | 2.88 |
| Missouri | | | | 2,077,448 | 872,976 | 2,950,424 | 1,088,378 | 15,418 | 26,701 | 4,091,394 | 6,436 | 152 | 4.18 |
| Montana [5] | | | | 575,208 | 2,192,550 | 2,767,758 | 204,244 | 8,195 | 4,275 | 2,965,193 | 1,503 | 186 | 10.62 |
| New Mexico | | | | 602,088 | 950,524 | 1,552,612 | 86,842 | 10,962 | 47,418 | 1,714,955 | 2,608 | 208 | 3.17 |
| North Dakota [5] | | | | 1,577,216 | | 1,577,216 | 663,811 | | 9,810 | 2,250,837 | 1,475 | 181 | 8.41 |
| Ohio | | 3,137,725 | 730,459 | 9,609,807 | 7,314,190 | 20,792,181 | 4,183,608 | 44,488 | 128,550 | 25,177,867 | 30,294 | 185 | 4.49 |
| Oklahoma | | | | 1,127,315 | 284,333 | 1,411,648 | 168,907 | 4,558 | 15,189 | 1,600,295 | 3,147 | 142 | 3.58 |
| Pennsylvania | 8,803,685 | 11,442,983 | 21,244,843 | 36,549,153 | 18,717,344 | 96,758,008 | 9,399,989 | 409,117 | [3] 4,441,262 | 111,002,289 | 133,897 | 199 | 4.16 |
| South Dakota [5] | | | | 26,444 | | 26,444 | 20,530 | | 5 | 46,979 | 47 | 165 | 6.05 |
| Tennessee | | 190,012 | | 2,541,207 | 2,081,345 | 4,812,564 | 289,054 | 35,729 | [3] 73,166 | 5,212,471 | 8,465 | 195 | 3.17 |
| Texas [5] | | | | 850,262 | 11,531 | 861,793 | 40,041 | 49 | 8,704 | 910,352 | 819 | 199 | 5.59 |
| Utah | 12,180 | | | 2,714,436 | 773,787 | 3,500,403 | 286,410 | 18,859 | [3] 18,353 | 3,809,476 | 3,417 | 189 | 5.88 |
| Virginia | 2,007,108 | 1,543,619 | | 7,388,313 | 2,077,975 | 13,017,015 | 246,228 | 79,980 | [3] 450,726 | 13,795,239 | 16,494 | 200 | 4.18 |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Washington | 16,385 | | | 910,833 | 517,806 | 1,445,024 | 470,851 | 18,359 | 21,199 | 2,001,449 | 2,882 | 204 | 3.40 |
| West Virginia | 19,919,591 | 18,628,479 | 5,421,922 | 55,006,125 | 15,251,387 | 114,227,504 | 2,531,248 | 686,753 | [3] 948,899 | 118,646,343 | 113,643 | 209 | 5.00 |
| Wyoming | | | | 1,325,730 | 4,204,500 | 5,530,230 | 222,544 | 36,290 | 125,554 | 5,918,359 | 4,743 | 204 | 6.11 |
| Other States [6] | | | | 5,751 | 5,120 | 10,871 | 13,091 | | 334 | 24,296 | 128 | 165 | 1.15 |
| | 31,718,697 | 44,111,898 | 27,810,076 | 206,290,965 | 89,305,939 | 399,237,575 | 35,705,706 | 2,056,906 | [3] 7,936,149 | 445,531,449 | 491,864 | 193 | 4.69 |

[1] Includes coal reported as "shipped to distributors, destinations unknown," a small part of which may have been forwarded to tidewater or Great Lakes.
[2] Includes coal taken by locomotives at tipple.
[3] Includes coal made into beehive coke at mines in the following States in 1937: Colorado, 115,278; Pennsylvania, 3,787,102; Tennessee, 26,560; Utah, 12,271; Virginia, 412,192; West Virginia, 530,651 (including a small amount of coal made into briquets); a grand total of 4,884,054 tons in 1937, against 2,728,577 in 1936. Does not include coal shipped in by rail or truck from mines to beehive ovens for coking, such tonnage being included under rail or truck deliveries.
[4] The total production differs from the sum of the items shown by the amount of the changes in inventory and of tonnage not accounted for in the distribution analysis.
[5] Includes figures on lignite from Bureau of Mines; see Lignite Tables, 1937. "Loaded at mines for shipment," as published by Bureau of Mines, included under "all-rail"; "commercial sales by truck or wagon" and "other sales to local trade, etc.," as published by Bureau of Mines, included under "truck deliveries including local sales."
[6] Arizona, California, Georgia, Idaho, and Oregon.



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## TOTAL PRODUCTION SINCE BEGINNING OF MINING

TABLE 7.—*Coal produced, 1927–37, by States, with production of maximum year and cumulative production from the earliest record to the end of 1937, in thousands of net tons*

| State | Maximum production | | Production by years | | | | | | | | | | | Total production from earliest record to end of 1937 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | Quantity | 1927 | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | |
| Alabama | 1926 | 21,001 | 19,766 | 17,621 | 17,944 | 15,570 | 11,999 | 7,857 | 8,760 | 9,142 | 8,505 | 12,229 | 12,440 | 627,966 |
| Arkansas | 1907 | 2,670 | 1,549 | 1,661 | 1,695 | 1,533 | 1,154 | 1,033 | 883 | 857 | 1,133 | 1,623 | 1,511 | 72,344 |
| Colorado | 1917 | 12,483 | 9,724 | 9,848 | 9,921 | 8,197 | 6,604 | 5,599 | 5,230 | 5,211 | 5,911 | 6,812 | 7,187 | 391,259 |
| Georgia | 1903 | 416 | 77 | 58 | 45 | 7 | 22 | 27 | 41 | 33 | (1) | (1) | (1) | (1) |
| Illinois | 1918 | 89,291 | 46,848 | 55,948 | 60,658 | 53,731 | 44,303 | 33,475 | 37,413 | 41,272 | 44,525 | 50,927 | 51,602 | 2,405,891 |
| Indiana | 1918 | 30,679 | 17,936 | 16,379 | 18,344 | 16,490 | 14,295 | 13,324 | 13,761 | 14,794 | 15,754 | 17,822 | 17,765 | 721,090 |
| Iowa | 1917 | 8,966 | 2,950 | 3,684 | 4,241 | 3,893 | 3,388 | 3,862 | 3,195 | 3,367 | 3,650 | 3,961 | 3,637 | 308,739 |
| Kansas | 1918 | 7,562 | 3,444 | 2,810 | 2,976 | 2,430 | 1,987 | 1,953 | 2,218 | 2,508 | 2,686 | 2,944 | 2,893 | 229,064 |
| Kentucky | 1927 | 69,124 | 69,124 | 61,860 | 60,463 | 51,209 | 39,964 | 35,300 | 36,100 | 38,525 | 40,761 | 47,522 | 47,086 | 1,209,969 |
| Maryland | 1907 | 5,533 | 2,815 | 2,687 | 2,649 | 2,271 | 2,006 | 1,429 | 1,531 | 1,627 | 1,678 | 1,704 | 1,549 | 239,947 |
| Michigan | 1907 | 2,036 | 757 | 617 | 805 | 661 | 359 | 446 | 407 | 622 | 628 | 626 | 562 | 43,916 |
| Missouri | 1917 | 5,671 | 3,064 | 3,733 | 4,030 | 3,853 | 3,621 | 4,070 | 3,432 | 3,352 | 3,646 | 3,985 | 4,091 | 212,286 |
| Montana | 1918 | 4,533 | 3,144 | 3,324 | 3,408 | 3,022 | 2,378 | 2,125 | 2,152 | 2,566 | 2,759 | 2,988 | 2,965 | 115,068 |
| New Mexico | 1918 | 4,023 | 2,935 | 2,712 | 2,623 | 1,969 | 1,553 | 1,263 | 1,226 | 1,259 | 1,389 | 1,597 | 1,715 | 104,770 |
| North Carolina | 1922 | 79 | 53 | 61 | 52 | 29 | 2 | 2 | 2 | 3 | (1) | (1) | (1) | (1) |
| North Dakota | 1937 | 2,251 | 1,528 | 1,650 | 1,862 | 1,700 | 1,519 | 1,740 | 1,782 | 1,754 | 1,956 | 2,215 | 2,251 | 37,823 |
| Ohio | 1920 | 45,878 | 15,800 | 15,641 | 23,689 | 22,552 | 20,411 | 13,909 | 19,589 | 20,691 | 21,153 | 24,110 | 25,178 | 1,335,547 |
| Oklahoma | 1920 | 4,849 | 3,818 | 3,501 | 3,774 | 2,794 | 1,908 | 1,255 | 1,238 | 1,208 | 1,229 | 1,540 | 1,600 | 129,030 |
| Pennsylvania bituminous | 1918 | 178,551 | 132,965 | 131,202 | 143,516 | 124,463 | 97,659 | 74,776 | 79,296 | 89,826 | 91,405 | 109,887 | 111,002 | 5,888,186 |
| Tennessee | 1910 | 7,121 | 5,783 | 5,611 | 5,405 | 5,130 | 4,721 | 3,538 | 3,775 | 4,136 | 4,138 | 5,108 | 5,213 | 250,197 |
| Texas | 1913 | 2,429 | 1,326 | 1,182 | 1,101 | 834 | 716 | 637 | 822 | 759 | 758 | 843 | 910 | 57,363 |
| Utah | 1920 | 6,005 | 4,781 | 4,843 | 5,161 | 4,258 | 3,350 | 2,852 | 2,675 | 2,406 | 2,947 | 3,247 | 3,810 | 131,604 |
| Virginia | 1926 | 14,133 | 12,916 | 11,901 | 12,748 | 10,907 | 9,699 | 7,692 | 8,179 | 9,377 | 9,667 | 11,662 | 13,795 | 349,074 |
| Washington | 1918 | 4,082 | 2,635 | 2,520 | 2,521 | 2,302 | 1,846 | 1,591 | 1,394 | 1,383 | 1,559 | 1,812 | 2,002 | 125,111 |
| West Virginia | 1927 | 145,122 | 145,122 | 132,952 | 138,519 | 121,473 | 101,473 | 85,609 | 94,344 | 98,134 | 99,179 | 117,926 | 118,646 | 3,250,331 |
| Wyoming | 1920 | 9,630 | 6,754 | 6,572 | 6,705 | 6,088 | 4,994 | 4,171 | 4,013 | 4,368 | 5,177 | 5,781 | 5,918 | 275,656 |
| Other States | | | 149 | 167 | 134 | 160 | 158 | 175 | 173 | 188 | 180 | 217 | 203 | 61,458 |
| Total bituminous | | | 517,763 | 500,745 | 534,989 | 467,526 | 382,089 | 309,710 | 333,631 | 359,368 | 372,373 | 439,088 | 445,531 | 18,573,689 |
| Pennsylvania anthracite | 1917 | 99,612 | 80,096 | 75,348 | 73,828 | 69,385 | 59,646 | 49,855 | 49,541 | 57,168 | 52,159 | 54,580 | 51,856 | 4,236,358 |
| Grand total | | | 597,859 | 576,093 | 608,817 | 536,911 | 441,735 | 359,565 | 383,172 | 416,536 | 424,532 | 493,668 | 497,387 | 22,810,047 |

[1] Included under "Other States."

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## PRODUCTION BY WEEKS AND MONTHS

The following tables summarize the statistics of weekly and monthly production of bituminous coal first published in the Commission's Weekly Coal Reports. The figures are estimates based on daily and weekly statements of cars of coal and beehive coke loaded by the principal railroads and of shipments over the more important originating rivers. The estimates are revised afterward to agree with the results of the annual statistical reports from the coal producers; therefore, the figures given here differ slightly from those issued originally in the weekly reports.

For the method used in counting holidays see chapter on Coal in Mineral Resources of the United States, 1930, page 631.

TABLE 8.—*Estimated weekly production of bituminous coal in 1937*

| Week ended | Production (net tons) | Number of working days | Average production per working day (net tons) | Week ended | Production (net tons) | Number of working days | Average production per working day (net tons) |
|---|---|---|---|---|---|---|---|
| Jan. 2 | [1] 1,482,000 | [1] 1.1 | [2] 1,792,000 | July 10 | 6,575,000 | 5 | 1,315,000 |
| Jan. 9 | 10,947,000 | 6 | 1,825,000 | July 17 | 7,250,000 | 6 | 1,208,000 |
| Jan. 16 | 10,600,000 | 6 | 1,767,000 | July 24 | 7,403,000 | 6 | 1,234,000 |
| Jan. 23 | 9,570,000 | 6 | 1,595,000 | July 31 | 7,837,000 | 6 | 1,306,000 |
| Jan. 30 | 8,839,000 | 6 | 1,473,000 | Aug. 7 | 7,478,000 | 6 | 1,246,000 |
| Feb. 6 | 10,018,000 | 6 | 1,670,000 | Aug. 14 | 7,738,000 | 6 | 1,290,000 |
| Feb. 13 | 10,305,000 | 6 | 1,718,000 | Aug. 21 | 7,715,000 | 6 | 1,286,000 |
| Feb. 20 | 10,990,000 | 6 | 1,832,000 | Aug. 28 | 8,058,000 | 6 | 1,343,000 |
| Feb. 27 | 11,348,000 | 5.9 | 1,923,000 | Sept. 4 | 8,580,000 | 6 | 1,430,000 |
| Mar. 6 | 11,240,000 | 6 | 1,873,000 | Sept. 11 | 7,863,000 | 5 | 1,573,000 |
| Mar. 13 | 11,435,000 | 6 | 1,906,000 | Sept. 18 | 9,249,000 | 6 | 1,542,000 |
| Mar. 20 | 11,365,000 | 6 | 1,894,000 | Sept. 25 | 9,620,000 | 6 | 1,603,000 |
| Mar. 27 | 11,503,000 | 6 | 1,917,000 | Oct. 2 | 9,826,000 | 6 | 1,638,000 |
| Apr. 3 | 7,241,000 | 5.2 | 1,393,000 | Oct. 9 | 9,704,000 | 6 | 1,617,000 |
| Apr. 10 | 5,860,000 | 6 | 977,000 | Oct. 16 | 9,867,000 | 6 | 1,645,000 |
| Apr. 17 | 6,380,000 | 6 | 1,063,000 | Oct. 23 | 9,680,000 | 6 | 1,613,000 |
| Apr. 24 | 6,705,000 | 6 | 1,118,000 | Oct. 30 | 9,347,000 | 6 | 1,558,000 |
| May 1 | 6,922,000 | 6 | 1,154,000 | Nov. 6 | 8,947,000 | 6 | 1,491,000 |
| May 8 | 7,014,000 | 6 | 1,169,000 | Nov. 13 | 9,032,000 | 5.5 | 1,642,000 |
| May 15 | 7,269,000 | 6 | 1,212,000 | Nov. 20 | 8,231,000 | 6 | 1,372,000 |
| May 22 | 7,422,000 | 6 | 1,237,000 | Nov. 27 | 7,520,000 | 5 | 1,504,000 |
| May 29 | 7,598,000 | 6 | 1,266,000 | Dec. 4 | 8,320,000 | 6 | 1,387,000 |
| June 5 | 6,696,000 | 5.3 | 1,263,000 | Dec. 11 | 10,346,000 | 6 | 1,724,000 |
| June 12 | 7,090,000 | 6 | 1,182,000 | Dec. 18 | 9,139,000 | 6 | 1,523,000 |
| June 19 | 7,178,000 | 6 | 1,196,000 | Dec. 25 | 6,405,000 | 5 | 1,281,000 |
| June 26 | 7,233,000 | 6 | 1,206,000 | Jan. 1 | [1] 6,176,000 | [1] 5 | [2] 1,221,000 |
| July 3 | 7,375,000 | 6 | 1,229,000 | | | | |
| | | | | | 445,531,000 | 306.0 | 1,456,000 |

[1] Figures represent output and number of working days in that part of the week included in the calendar year shown. Total production for the week of January 2, 1937, was 9,141,000 net tons; for the week of January 1, 1938, 6,225,000.

[2] Average daily production for the entire week and not for the working days in the calendar year shown.

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TABLE 9.—*Monthly production of coal in 1937, by States, in thousands of net tons*

[The totals for the year are based on final complete returns to the National Bituminous Coal Commission from all operators known to have produced more than 1,000 tons a year. The apportionment of the known yearly total among the 12 months is based upon the best information available, in some States upon direct tonnage reports by operators to the State mine department, in most cases upon current records of railroad carloadings and waterway shipments.]

| State | January | February | March | April | May | June | July | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 1,193 | 1,204 | 1,453 | 116 | 781 | 1,053 | 1,123 | 1,104 | 1,106 | 1,109 | 1,043 | 1,155 | 12,440 |
| Alaska | 9 | 8 | 9 | 12 | 10 | 13 | 12 | 11 | 13 | 14 | 8 | 13 | 132 |
| Arkansas | 247 | 154 | 75 | 8 | 9 | 12 | 79 | 149 | 183 | 217 | 157 | 221 | 1,511 |
| Colorado | 946 | 825 | 771 | 302 | 365 | 363 | 337 | 405 | 585 | 708 | 729 | 851 | 7,187 |
| Illinois | 5,695 | 5,789 | 6,967 | 2,114 | 2,239 | 2,674 | 2,939 | 3,230 | 4,377 | 5,030 | 4,897 | 5,651 | 51,602 |
| Indiana | 1,671 | 1,943 | 2,358 | 691 | 1,008 | 1,110 | 1,052 | 1,137 | 1,519 | 1,583 | 1,642 | 2,051 | 17,765 |
| Iowa | 499 | 504 | 542 | 78 | 97 | 90 | 115 | 217 | 317 | 369 | 382 | 427 | 3,637 |
| Kansas | 349 | 327 | 392 | 26 | 132 | 165 | 177 | 237 | 239 | 259 | 270 | 320 | 2,893 |
| Kentucky: | | | | | | | | | | | | | |
| Eastern | 2,790 | 2,580 | 4,100 | 3,018 | 3,278 | 3,086 | 3,010 | 3,054 | 3,658 | 3,733 | 3,168 | 3,048 | 38,523 |
| Western | 695 | 669 | 1,278 | 423 | 498 | 520 | 539 | 597 | 739 | 807 | 800 | 998 | 8,563 |
| Maryland | 162 | 161 | 193 | 78 | 76 | 107 | 110 | 121 | 132 | 141 | 138 | 130 | 1,549 |
| Michigan | 80 | 88 | 84 | 10 | 4 | 13 | 18 | 26 | 52 | 59 | 60 | 68 | 562 |
| Missouri | 515 | 473 | 524 | 191 | 171 | 167 | 186 | 225 | 317 | 382 | 390 | 550 | 4,091 |
| Montana | 330 | 308 | 316 | 125 | 130 | 166 | 175 | 193 | 258 | 326 | 337 | 301 | 2,965 |
| New Mexico | 182 | 185 | 191 | 125 | 113 | 121 | 133 | 123 | 132 | 144 | 129 | 137 | 1,715 |
| North Dakota | 321 | 315 | 200 | 90 | 61 | 59 | 56 | 77 | 182 | 298 | 288 | 304 | 2,251 |
| Ohio | 2,261 | 2,528 | 2,957 | 1,334 | 1,891 | 1,922 | 1,750 | 1,792 | 2,196 | 2,315 | 2,156 | 2,076 | 25,178 |
| Oklahoma | 191 | 161 | 162 | 27 | 40 | 58 | 64 | 134 | 139 | 222 | 182 | 220 | 1,600 |
| Pennsylvania bituminous | 10,352 | 10,956 | 12,997 | 7,611 | 8,204 | 8,643 | 8,628 | 8,907 | 9,722 | 9,594 | 7,963 | 7,425 | 111,002 |
| South Dakota | 9 | 7 | 3 | 1 | 2 | 1 | 2 | 2 | 4 | 6 | 4 | 6 | 47 |
| Tennessee | 470 | 467 | 588 | 173 | 368 | 437 | 425 | 423 | 463 | 483 | 492 | 424 | 5,213 |
| Texas | 61 | 63 | 69 | 63 | 67 | 78 | 86 | 91 | 92 | 83 | 77 | 80 | 910 |
| Utah | 525 | 495 | 442 | 137 | 118 | 153 | 187 | 248 | 347 | 394 | 354 | 410 | 3,810 |
| Virginia | 1,188 | 1,155 | 1,516 | 735 | 1,007 | 1,023 | 1,073 | 1,173 | 1,294 | 1,384 | 1,145 | 1,102 | 13,795 |
| Washington | 239 | 225 | 177 | 125 | 125 | 145 | 132 | 136 | 156 | 184 | 178 | 180 | 2,002 |
| West Virginia | 9,766 | 10,422 | 12,975 | 8,311 | 9,210 | 9,447 | 9,456 | 9,972 | 10,677 | 10,633 | 9,136 | 8,641 | 118,646 |
| Wyoming | 689 | 646 | 593 | 288 | 266 | 361 | 319 | 402 | 527 | 631 | 571 | 625 | 5,918 |
| Other States [1] | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 24 |
| Total bituminous coal | 41,438 | 42,661 | 51,935 | 26,213 | 30,271 | 31,988 | 32,184 | 34,187 | 39,428 | 41,110 | 36,699 | 37,417 | 445,531 |
| Pennsylvania anthracite [2] | 4,236 | 3,671 | 4,795 | 6,779 | 4,361 | 4,635 | 2,748 | 2,903 | 3,682 | 4,848 | 4,439 | 4,759 | 51,856 |
| Grand total | 45,674 | 46,332 | 56,730 | 32,992 | 34,632 | 36,623 | 34,932 | 37,090 | 43,110 | 45,958 | 41,138 | 42,176 | 497,387 |

[1] Arizona, California, Georgia, Idaho, and Oregon.

[2] Pennsylvania anthracite figures from Bureau of Mines. Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations.

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## NUMBER AND SIZE OF MINES

The 1937 survey of the bituminous-coal industry is based on records of 6,548 mines that produced 1,000 tons or more during the year. Although this is somewhat less than the 6,875 mines in the 1936 survey it is more than in any other year since 1927. The upward trend in the number of mines from the low of 5,427 in 1932 has been due in considerable measure to the opening of small truck mines in sections that have gained access to markets through the development of hard roads and cheap motor transport. The increase has been influenced by the presence of unemployed miners seeking a means of livelihood within their own trade. Furthermore, part of the rise in the number of mines resulted from the more intensive enumeration of small producers by both State and Federal agencies in recent years. This applies especially to 1936, when data on the production of numerous small mines were drawn from the code acceptance records.

The regulatory functions of the National Bituminous Coal Commission made it necessary to prepare a list of all coal producers, regardless of size, down to the smallest wagon mine or country bank. The list compiled originally has been revised from time to time in accordance with the latest information from the field. A total of 11,612 code acceptances was on file June 10, 1939, with the names of 4,303 supposed producers who had not applied for code membership. Many of the latter undoubtedly represent coal banks no longer in operation or are carried in the list of code members under another name. Although a majority of the nominal total of 15,915 producers have an output of less than 1,000 tons a year the record discloses a number of mines above the 1,000-ton limit that have not been listed previously by either Federal or State mine departments. Since the code acceptances included reports of the code members' output in 1936 they served as a supplementary record of production for that year. Some of the small mines that were added to the 1936 production on the basis of these records, however, did not furnish any data for 1937, so that the count for the latter year is slightly less complete.

The Federal enumerations for 1936 and 1937 were supplemented by increasing attention to statistics of small mines by certain State mine departments, such as those of Alabama, Indiana, Pennsylvania, and West Virginia.

The change in coverage of small mines, however, affects the comparability of the record only as far as the number of mines is concerned. Although nearly 60 percent of all mines included in the 1937 report fell in the less than 10,000 tons per year class the combined production for this group was less than 3 percent of the total for the country; consequently the change in the number of mines has very little effect upon comparability of the tonnage figures.

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TABLE 10.—*Number and production of commercial bituminous-coal mines in the United States in 1937,*[1] *classified by size of output in each State*

[Exclusive of product of truck and wagon mines producing less than 1,000 tons]

| State | Class 1A, over 500,000 net tons | | Class 1B, 200,000–500,000 net tons | | Class 2, 100,000–200,000 net tons | | Class 3, 50,000–100,000 net tons | | Class 4, 10,000–50,000 net tons | | Class 5, less than 10,000 net tons | | Total all classes | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of mines | Quantity | Number of mines | Quantity | Number of mines | Quantity | Number of mines | Quantity | Number of mines | Quantity | Number of mines | Quantity | Number of mines | State total |
| Alabama | 8 | 4,975,061 | 9 | 2,634,763 | 18 | 2,480,505 | 20 | 1,586,995 | 16 | 364,127 | 123 | 398,871 | 194 | 12,440,322 |
| Alaska | | | | | | | 1 | 81,474 | 1 | 45,142 | 2 | 5,041 | 4 | 131,657 |
| Arkansas | | | | | | | 8 | 486,371 | 38 | 910,349 | 34 | 114,033 | 80 | 1,510,753 |
| Colorado | 1 | 545,807 | 6 | 1,348,267 | 19 | 2,791,196 | 15 | 1,043,194 | 49 | 999,189 | 148 | 459,558 | 238 | 7,187,211 |
| Illinois | 33 | 28,200,482 | 36 | 12,985,292 | 23 | 3,209,329 | 41 | 2,929,415 | 125 | 2,990,118 | 401 | 1,287,002 | 659 | 51,601,638 |
| Indiana | 9 | 6,394,334 | 18 | 5,397,259 | 17 | 2,351,419 | 21 | 1,506,771 | 71 | 1,556,262 | 136 | 558,729 | 272 | 17,764,774 |
| Iowa | | | 2 | 520,705 | 1 | 178,524 | 11 | 884,698 | 55 | 1,239,475 | 271 | 813,652 | 340 | 3,637,054 |
| Kansas | | | 4 | 1,076,423 | 4 | 667,493 | 5 | 364,266 | 20 | 476,566 | 123 | 307,812 | 156 | 2,892,560 |
| Kentucky: | | | | | | | | | | | | | | |
| Eastern | 15 | 11,998,407 | 43 | 13,664,936 | 50 | 7,196,526 | 52 | 3,787,404 | 58 | 1,589,764 | 117 | 286,517 | 335 | 38,523,554 |
| Western | 1 | 553,544 | 14 | 3,821,240 | 18 | 2,305,320 | 11 | 825,916 | 32 | 785,114 | 84 | 271,756 | 160 | 8,562,890 |
| Maryland | | | | | 3 | 480,027 | 5 | 377,509 | 19 | 506,417 | 63 | 185,027 | 90 | 1,548,980 |
| Michigan | | | | | 1 | 167,234 | 3 | 212,085 | 8 | 176,916 | 3 | 6,027 | 15 | 562,262 |
| Missouri | 1 | 547,417 | 5 | 1,387,049 | 1 | 173,516 | 7 | 476,926 | 41 | 923,809 | 208 | 582,677 | 263 | 4,091,394 |
| Montana, North Dakota, South Dakota, and Texas [2] | 1 | 1,247,337 | 8 | 2,578,476 | 6 | 995,829 | 4 | 282,476 | 27 | 544,511 | 263 | 524,732 | 309 | 6,173,361 |
| New Mexico | | | 2 | 666,975 | 4 | 595,438 | 5 | 281,209 | 5 | 91,975 | 33 | 79,358 | 49 | 1,714,955 |
| Ohio | 13 | 9,834,120 | 20 | 6,498,124 | 23 | 3,364,064 | 23 | 1,706,141 | 99 | 2,203,757 | 558 | 1,571,661 | 736 | 25,177,867 |
| Oklahoma | | | | | 2 | 382,234 | 6 | 399,561 | 23 | 594,636 | 74 | 223,864 | 105 | 1,600,295 |
| Pennsylvania | 59 | 51,948,250 | 89 | 28,053,680 | 109 | 15,549,713 | 93 | 7,173,797 | 261 | 5,753,624 | 726 | 2,523,225 | 1,337 | 111,002,289 |
| Tennessee | | | 8 | 2,147,497 | 13 | 1,716,196 | 10 | 677,352 | 20 | 468,863 | 79 | 202,563 | 130 | 5,212,471 |
| Utah | | | 7 | 2,089,164 | 6 | 811,043 | 8 | 574,153 | 8 | 224,757 | 31 | 110,359 | 60 | 3,809,476 |
| Virginia | 6 | 4,224,801 | 20 | 5,634,904 | 14 | 2,106,736 | 17 | 1,221,690 | 15 | 470,325 | 55 | 136,783 | 127 | 13,795,239 |
| Washington | | | 3 | 749,087 | 4 | 620,391 | 1 | 66,457 | 16 | 430,453 | 35 | 135,061 | 59 | 2,001,449 |
| West Virginia | 62 | 45,519,753 | 148 | 45,591,236 | 126 | 18,870,684 | 74 | 5,528,553 | 99 | 2,411,464 | 245 | 724,653 | 754 | 118,646,343 |
| Wyoming | 3 | 1,671,087 | 7 | 2,167,742 | 7 | 1,138,780 | 7 | 546,309 | 10 | 306,829 | 31 | 87,612 | 65 | 5,918,359 |
| Other States [3] | | | | | | | | | 1 | 11,205 | 10 | 13,091 | 11 | 24,296 |
| Grand total | 212 | 167,660,400 | 449 | 139,012,819 | 469 | 68,152,197 | 448 | 33,020,722 | 1,117 | 26,075,647 | 3,853 | 11,609,664 | 6,548 | 445,531,449 |

[1] As in 1935 and 1936, the 1937 figures of total number of mines and of number in class 5 (less than 10,000 tons) are not comparable with years before 1934 in a number of States because of more complete coverage of small trucking mines (producing more than 1,000 tons per year). See Minerals Yearbook, 1936, pp. 561–564.

[2] Includes lignite figures from Bureau of Mines.

[3] Arizona, California, Georgia, Idaho, and Oregon.

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### TREND OF AVERAGE VALUE PER TON, F. O. B. MINES, 1929 TO 1937

Before the Bituminous Coal Act of 1937 was passed the most valuable single index of the trend of prices at the mines was the "average value per ton, f. o. b. mines," as given in the familiar annual coal reports of the Bureau of Mines, United States Department of the Interior. This series was referred to in the Bureau of Mines reports as representing "bituminous coal," and it covered all coal other than Pennsylvania anthracite produced in the United States. It represented the bituminous-coal industry as the term ordinarily was used in the trade and included the lignite of the Dakotas, Texas, and Montana, as well as any small tonnages of hard coal produced outside of Pennsylvania.

With the passage of the Coal Act the Bureau of Mines relinquished the collection of statistics relating to bituminous coal, effective June 30, 1937, though continuing to compile data regarding lignite. Effective on the same date, the Coal Commission became responsible for the compilation of data on bituminous coal, though not attempting to collect data regarding lignite, which was specifically exempted by the act. The records of the Commission relate to all coal other than Pennsylvania anthracite and lignite, no exemptions other than lignite having been approved under the act.

To permit comparison of the old and new series, therefore, it is necessary to separate the lignites from the bituminous coals, though for convenience of the student, the combined average for the two is continued in a form as nearly comparable as possible to the old series.

A more important change in the two series relates to the treatment of selling expenses. The old Bureau of Mines series of "value at the mines" excluded the selling cost. The reporting operator was asked to state the "Amount received at the mines f. o. b. cars less the selling expense." No details were asked regarding the items included in the value, and no systematic effort was made to follow up the exclusion of selling expenses. It was realized at the time that some producers might find it impractical to exclude selling costs and that some part of the selling expenses of the industry might be included in the results. Nevertheless, the reports were checked for consistency from year to year, the questions were retained in the same form without change, and the results are believed to have been comparable from one year to the next. The new series of the Coal Commission represents the total or gross realization on all coal produced and specifically includes the selling cost.

It is also possible that the two sets of data are not precisely comparable with respect to coal produced but not sold on the commercial market. In the Bureau of Mines series the reporting operator was instructed that the "value of coal not sold but used by producer, also mine fuel and coal made into coke should be estimated at average prices that might have been received." The instructions of the Coal Commission regarding such items were in effect similar, though given in greater detail.

A comparison of the two series is possible for 1936. In that year the average value per ton on the old (Bureau of Mines) basis amounted to $1.761 per ton for bituminous coal excluding lignite. The average gross realization, as collected by the Coal Commission, was $1.831 per ton. The difference amounts to $0.07 per ton, an amount some-

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what less than the average selling expenditure computed per ton of all coal produced, as reported to the Coal Commission. The comparison confirms previous indications that the great majority of operators reporting in earlier years had followed instructions and omitted selling expenses in computing the average value but that some of them had included the selling expense. The change in method of reporting should be kept in mind in comparing the two sets of data. As the reports to the Commission were submitted on a detailed accounting return and made under oath they are to be accepted. The returns of earlier years, on a voluntary basis and not in all instances uniform as to treatment of selling costs, seem to have been thoroughly comparable from one year to the next and afford the best available index to the rise and fall of the mine prices received by the operator down to 1936.

TABLE 11.—*Trend of average value per ton, f. o. b. mines, 1929–37*

| Year | Bituminous [1] coal (subject to regulation under 1937 Act) | Lignite [2] | Total |
|---|---|---|---|
| Average value per ton less selling expense (Bureau of Mines series): | | | |
| 1929 | $1.782 | $1.548 | $1.781 |
| 1930 | 1.702 | 1.556 | 1.701 |
| 1931 | 1.542 | 1.410 | 1.541 |
| 1932 | 1.313 | 1.313 | 1.313 |
| 1933 | 1.337 | 1.188 | 1.336 |
| 1934 | 1.751 | 1.387 | 1.749 |
| 1935 | 1.772 | 1.120 | 1.767 |
| 1936 | 1.761 | 1.061 | 1.756 |
| Average gross realization including selling expense (Coal Commission series): | | | |
| 1936 | 1.831 | [3] 1.061 | 1.826 |
| 1937 | 1.946 | [3] 1.080 | 1.939 |

[1] Includes all coal produced other than Pennsylvania anthracite and the lignite included in the second column.
[2] North Dakota, South Dakota, and the lignite counties of Montana and Texas.
[3] Figures of the Bureau of Mines, excluding selling expense as before. Data on sales realization were not collected from lignite mines by the Coal Commission.

## SPOT PRICES

Spot prices afford a basis for measuring the relative strength of the forces of demand and supply in the competitive market for bituminous coal. The market quotations published in the leading trade magazines usually are based on posted prices of larger producers, and oftentimes represent "asked" rather than "actual" prices.

Spot prices are not to be confused with sales realization, since the latter includes a large volume of coal either sold at relatively stable prices under long-term contracts or consumed by producers and their affiliates at purely nominal prices.

The following table of average spot prices is offered as an indication of trends in 1937 and 1938.

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TABLE 12.—*Trend of spot prices of bituminous coal per net ton, f. o. b. mines as indicated by trade journal quotations, 1937–38* [1]

[Based on 130 series of comparable quotations currently published in the Black Diamond, Saward's Journal, and Chicago Journal of Commerce. These have been grouped into prepared sizes, run-of-mine, and screenings or slack, and simple averages obtained. The three groups have then been combined into a weighted average, counting prepared sizes at 43 percent, run-of-mine at 27 percent, and screenings or slack at 30 percent. The resulting average for all coal is not intended to show the actual realization obtained, but gives a ready comparison of the trend of prices in the 2 years]

| Month | Prepared sizes | | | Run-of-mine | | | Screenings or slack | | | All coal | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 | Change from 1937 [2] | 1937 | 1938 | Change from 1937 [2] | 1937 | 1938 | Change from 1937 [2] | 1937 | 1938 | Change from 1937 [2] |
| January [3] | $2.49 | $2.58 | +$0.09 | $2.06 | $2.22 | +$0.16 | $1.49 | $1.81 | +$0.32 | $2.07 | $2.25 | +$0.18 |
| February [3] | 2.49 | 2.54 | +.05 | 2.07 | 2.21 | +.14 | 1.54 | 1.77 | +.23 | 2.09 | 2.22 | +.13 |
| March | 2.39 | 2.48 | +.09 | 2.06 | 2.07 | +.01 | 1.70 | 1.50 | −.20 | 2.09 | 2.08 | −.01 |
| April | 2.30 | 2.22 | −.08 | 2.11 | 2.08 | −.03 | 1.77 | 1.51 | −.26 | 2.09 | 1.99 | −.10 |
| May | 2.30 | 2.21 | −.09 | 2.13 | 2.07 | −.06 | 1.77 | 1.51 | −.26 | 2.10 | 1.96 | −.14 |
| June [3] | 2.29 | 2.22 | −.07 | 2.13 | 2.07 | −.06 | 1.77 | 1.51 | −.26 | 2.09 | 1.97 | −.12 |
| July | 2.33 | 2.23 | −.10 | 2.07 | 2.07 | ------- | 1.74 | 1.47 | −.27 | 2.08 | 1.96 | −.12 |
| August | 2.38 | 2.28 | −.10 | 2.10 | 2.06 | −.04 | 1.72 | 1.41 | −.31 | 2.11 | 1.96 | −.15 |
| September | 2.39 | 2.34 | −.05 | 2.10 | 2.10 | ------- | 1.64 | 1.37 | −.27 | 2.09 | 1.98 | −.11 |
| October | 2.44 | 2.47 | +.03 | 2.10 | 2.10 | ------- | 1.60 | 1.38 | −.22 | 2.10 | 2.04 | −.06 |
| November | 2.45 | 2.45 | ------- | 2.11 | 2.07 | −.04 | 1.59 | 1.33 | −.26 | 2.10 | 2.01 | −.09 |
| December [3] | 2.49 | 2.43 | −.06 | 2.16 | 2.06 | −.10 | 1.71 | 1.34 | −.37 | 2.17 | 2.00 | −.17 |
| Average: | | | | | | | | | | | | |
| 12 months | 2.40 | 2.37 | −.03 | 2.10 | 2.10 | ------- | 1.67 | 1.49 | −.18 | 2.10 | 2.04 | −.06 |
| 9 months (April to December) | 2.37 | 2.32 | −.05 | 2.11 | 2.08 | −.03 | 1.70 | 1.43 | −.27 | 2.10 | 1.99 | −.11 |

[1] Except as noted, these averages are based upon the following number of quotations: Prepared sizes: Chicago market, 25 quotations; Cleveland market, 29 quotations; Norfolk market, 18 quotations; Pittsburgh market, 3 quotations; total, 75 quotations. Run-of-mine: Chicago market, 7 quotations; Cleveland market, 2 quotations; Norfolk market, 7 quotations; Pittsburgh market, 0; total, 16 quotations. Screenings or slack: Chicago market, 19 quotations; Cleveland market, 11 quotations; Norfolk market, 7 quotations; Pittsburgh market, 2 quotations; total, 39 quotations. Total of all quotations used, 130.

[2] The increase in miners' wages after April 1, 1937, and the higher level of minimum prices during January and February 1938 must be taken into consideration when comparing prices for the first 3 months of 1937 and 1938.

[3] No quotations for Cleveland or Pittsburgh in January and February, or for Pittsburgh in June and December.

## LABOR STATISTICS

### MEN EMPLOYED

An average of 491,864 men was employed at bituminous-coal mines in 1937, an increase of 3 percent over the reported total of 477,204 for 1936. (See fig. 6.)

In general, these figures of average numbers employed represent the normal working force on the rolls of the mine during periods of active operation. The factor of intermittent employment, so characteristic of coal mining, has a marked effect on the earnings of the men, but it can best be treated by maintaining a separate record of the number of days operated during the year.

As outlined in the section "Sources of Data and Acknowledgments." the National Bituminous Coal Commission did not make a direct canvass of employment in the coal industry in 1937. All employment data in this report have been abstracted from records compiled by the various State departments of mines and other sources. Although the schedules that these agencies used in collecting the original data differed in many respects and although none were identical with the standard form used by the Bureau of Mines for the 1935 and by the Commission for the 1936 surveys the results for 1937 in general are fairly comparable with similar data in previous reports.

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Among the problems encountered was classification of beehive-coke workers and office force. The standard schedule previously used by the Bureau of Mines had directed that these occupations be excluded. The State schedules for 1937 treated them in various ways. Some States followed the Federal practice and directed that coke and office workers be excluded. Others directed that they be reported. Where such was the practice an effort was made to deduct them from the total working force of the mine in question, and this could be done for Ohio and West Virginia, the figures for West Virginia excluding also supervisory officials. In Pennsylvania coke workers were deducted but office employees could not be. In Illinois, also, office employees were not eliminated. Several of the States, however, gave no specific instructions as to the occupations to be returned. It appears therefore that the employment figures in the present report may have a slight upward bias, due to the inclusion in some States of workers not

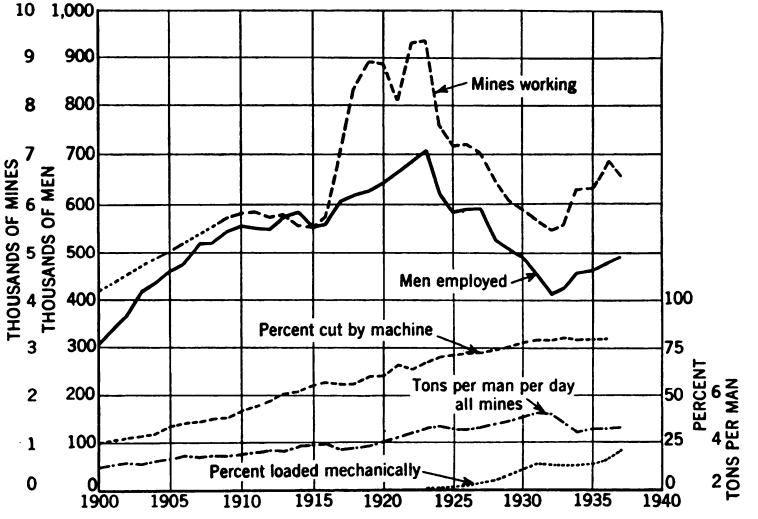


FIGURE 6.—Trends of employment, mechanization, and output per man at bituminous-coal mines, 1900–1937.

actually engaged in mining. The number so included is unimportant. The manufacture of beehive coke has shrunk to small proportions and outside of Pennsylvania and West Virginia, where coke workers are excluded, is confined to a few mines only. The number of office workers is small. In Ohio, for example, they comprised 0.9 percent of all employees. In West Virginia, where an occupational break-down is available, coke workers, office, and supervisory employees combined amounted to only 2.5 percent of all coal-mine employees.

The questionnaire for 1936 called for the number of men employed at each of the 12 pay periods nearest the fifteenth of the month. The average number of employees could then be computed accurately, excluding any pay periods when the mines were shut down and were giving employment only to maintenance men. Since employment data by months were procured by only a few of the States the former method of obtaining annual averages could not be used in the 1937

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report. As a consequence of these as well as other differences comparisons between the employment data for 1937 and similar data for earlier years must be made with qualifications.[3]

In recent years a special problem has arisen in recording of employment through the adoption of local "share-the-work" agreements, by which the employees of a mine are divided into two crews or groups who work on alternate days. Such agreements for "staggering" or alternating the work are not to be confused with the practice of operating both a day and a night shift but relate rather to division of the available work between two groups of workers on the same shift, usually the day shift.

Specific inquiries regarding such agreements by the Department of Mines and Minerals in Illinois in 1937 indicated that 53 mines were operating with alternate crews under share-the-work agreements. If the number of men on the pay rolls had been used as a measure of employment instead of the average number of men working the employment figures for Illinois would have been increased approximately 7 percent. A small number of employees was involved in similar reports from Indiana.

The figures on "number of men employed" as given in this report are therefore somewhat less than the total number of men on the rolls in the States where there were mines that followed the practice of spreading employment by means of share-the-work agreements. No formal agreements for dividing work have been reported to the authors from mines outside of Illinois and Indiana in 1937; however, local share-the-work agreements may have existed in other fields, which were not reported, and occasionally at still other mines a certain amount of work-sharing may have been practiced without written agreement between operators and their employees.

### DAYS OPERATED

The average number of days of operation for bituminous-coal mines in 1937 was 193.[4] This represents a slight decline from the average of 199 days for 1936. All statistics on days of mine operation included in this report are weighted averages, in which the operating time of each mine has been weighted by the number of its employees. Several coal-mining States publish series on the number of days worked that are simple averages of the figures for each reporting mine without regard to size. As these unweighted averages are likely to be unduly depressed by small mines, which generally operate fewer days than the larger ones, they tend to understate the working time of the typical mine employee.

### MAN-DAYS OF LABOR

Only a small proportion of the bituminous-mine operations, however, keep an accurate record of the man-days or man-hours worked. Consequently, man-days have been computed by multiplying the

[3] The statistical problems of measuring employment are fully discussed in two studies published by the Works Progress Administration, National Research Project on Reemployment Opportunities and Recent Changes in Industrial Techniques: Employment and Related Statistics of Mines and Quarries, 1935, Part I, Bituminous Coal, by F. G. Tryon and others, pp. 12–17; Mechanization, Employment, and Output Per Man in Bituminous-Coal Mining, by Willard E. Hotchkiss and others.

[4] Derived from the reports submitted by individual mines to the State inspection departments or other sources drawn upon. It is believed that a uniform return upon the standard questionnaire used by the Bureau of Mines in earlier years would show a slightly higher result, probably, 194 days. For practical purposes, however, the 1937 figures are comparable.

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number of workers employed by the number of operating days. Although these computations were made for each individual mine the combined total is necessarily an approximation.

Until the American coal industry arranges to keep an accurate record of the man-days or man-hours of employment, all computations of accident rates, daily earnings, and output per man will remain subject to qualification. Meanwhile, the method of multiplying men by days must be accepted as the best available procedure.

Data for 1937 indicate that bituminous-coal-mine employees performed 95,015,641 man-days of labor during the year. Table 6 gives a summary record of men employed, days operated, and output per man per day at bituminous-coal mines by States in 1937. Details by counties for 1937 are shown in table 39. Comparisons between 1937 and earlier years, however, are subject to the limitations imposed by the diversity of the schedules that the various agencies used in collecting the original data.

### LENGTH OF WORKING DAY

Data for computing the number of hours in the average working day of bituminous-coal miners were not available for 1937. Since there was no change in the provision of the union wage agreement regarding hours of work it can be assumed that the 7.02-hour-per-day average for 1935 and 1936 also would apply to 1937. For further discussion of length of working day and detailed statistics of earlier years, see Minerals Yearbook, 1937, pages 821–823.

## EQUIPMENT AND METHODS OF MINING AND PREPARATION, 1936–38

Statistics of strip mining, machine cutting, mechanical loading, and mechanical cleaning for 1936 were omitted from Minerals Yearbook, 1938, because of lack of space. To maintain the continuity of the series and to provide a permanent record of the essential data it seems advisable, therefore, to include the 1936 tables on equipment, methods of mining, and preparation in the following section along with such data for 1937 and 1938 as are now available.

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TABLE 13.—*Bituminous coal mined from underground workings and strip pits, 1936–37, by States*

| State | Net tons | | | | | | Percent | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1936 | | | 1937 | | | 1936 | | | 1937 | | |
| | Underground | Strip | Total | Underground | Strip | Total | Underground | Strip | Total | Underground | Strip | Total |
| Alabama | 12,177,133 | 52,154 | 12,229,287 | 12,404,054 | 36,268 | 12,440,322 | 99.6 | 0.4 | 100.0 | 99.7 | 0.3 | 100.0 |
| Alaska | 136,593 | | 136,593 | 131,657 | | 131,657 | 100.0 | | 100.0 | 100.0 | | 100.0 |
| Arkansas | 1,567,672 | 55,115 | 1,622,787 | 1,482,281 | 28,472 | 1,510,753 | 96.6 | 3.4 | 100.0 | 98.1 | 1.9 | 100.0 |
| Illinois | 41,813,930 | 9,112,669 | 50,926,599 | 40,152,906 | 11,448,732 | 51,601,638 | 82.1 | 17.9 | 100.0 | 77.8 | 22.2 | 100.0 |
| Indiana | 10,142,735 | 7,679,801 | 17,822,536 | 9,483,772 | 8,281,002 | 17,764,774 | 56.9 | 43.1 | 100.0 | 53.4 | 46.6 | 100.0 |
| Iowa | 3,688,166 | 272,534 | 3,960,700 | 3,218,103 | 418,951 | 3,637,054 | 93.1 | 6.9 | 100.0 | 88.5 | 11.5 | 100.0 |
| Kansas | 918,314 | 2,025,714 | 2,944,028 | 925,909 | 1,966,651 | 2,892,560 | 31.2 | 68.8 | 100.0 | 32.0 | 68.0 | 100.0 |
| Maryland | 1,703,589 | | 1,703,589 | 1,548,980 | | 1,548,980 | 100.0 | | 100.0 | 100.0 | | 100.0 |
| Michigan | 626,145 | | 626,145 | 562,262 | | 562,262 | 100.0 | | 100.0 | 100.0 | | 100.0 |
| Missouri | 1,524,250 | 2,460,749 | 3,984,999 | 1,437,227 | 2,654,167 | 4,091,394 | 38.2 | 61.8 | 100.0 | 35.1 | 64.9 | 100.0 |
| Montana and Texas [1] | 2,518,453 | 1,312,695 | 3,831,148 | 2,539,634 | 1,335,911 | 3,875,545 | 65.7 | 34.3 | 100.0 | 65.5 | 34.5 | 100.0 |
| New Mexico | 1,596,775 | | 1,596,775 | 1,714,955 | | 1,714,955 | 100.0 | | 100.0 | 100.0 | | 00.0 |
| North Dakota [1] | 848,414 | 1,366,921 | 2,215,335 | 903,482 | 1,347,355 | 2,250,837 | 38.3 | 61.7 | 100.0 | 40.1 | 59.9 | 00.0 |
| Ohio | 21,651,962 | 2,458,116 | 24,110,078 | 22,709,243 | 2,468,624 | 25,177,867 | 89.8 | 10.2 | 100.0 | 90.2 | 9.8 | 100.0 |
| Oklahoma | 1,196,705 | 343,598 | 1,540,303 | 1,134,360 | 465,935 | 1,600,295 | 77.7 | 22.3 | 100.0 | 70.9 | 29.1 | 100.0 |
| Pennsylvania | 109,133,686 | 753,784 | 109,887,470 | 110,148,345 | 853,944 | 111,002,289 | 99.3 | .7 | 100.0 | 99.2 | .8 | 100.0 |
| South Dakota [1] | 7,814 | 33,517 | 41,331 | 4,885 | 42,094 | 46,979 | 18.9 | 81.1 | 100.0 | 10.4 | 89.6 | 100.0 |
| Tennessee | 5,108,195 | | 5,108,195 | 5,212,471 | | 5,212,471 | 100.0 | | 100.0 | 100.0 | | 100.0 |
| Utah | 3,246,565 | | 3,246,565 | 3,809,476 | | 3,809,476 | 100.0 | | 100.0 | 100.0 | | 100.0 |
| Virginia | 11,661,636 | | 11,661,636 | 13,795,239 | | 13,795,239 | 100.0 | | 100.0 | 100.0 | | 100.0 |
| Washington | 1,812,104 | | 1,812,104 | 2,001,449 | | 2,001,449 | 100.0 | | 100.0 | 100.0 | | 100.0 |
| Wyoming | 5,637,896 | 142,694 | 5,780,590 | 5,750,560 | 167,799 | 5,918,359 | 97.5 | 2.5 | 100.0 | 97.2 | 2.8 | 100.0 |
| Other States [2] | 172,243,314 | 55,796 | 172,299,110 | 172,709,346 | 234,948 | 172,944,294 | 100.0 | (3) | 100.0 | 99.9 | .1 | 100.0 |
| Grand total | 410,962,046 | 28,125,857 | 439,087,903 | 413,780,596 | 31,750,853 | 445,531,449 | 93.6 | 6.4 | 100.0 | 92.9 | 7.1 | 100.0 |

[1] Includes lignite figures from Bureau of Mines.
[2] Arizona, California, Colorado, Georgia, Idaho, Kentucky, Oregon, and West Virginia; individual figures for strip mining for these States cannot be revealed.
[3] Less than 0.05 percent.



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## STRIPPING OPERATIONS IN 1936 AND 1937

### TABLE 14.—*Stripping operations of all types in bituminous-coal fields in 1936, by States and counties*

[Returns for mines that recover coal both by stripping and by underground operations do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

| State and county | Number of strip pits | Number of power shovels | | | Coal produced (net tons) | | Number of employees | | | | Average number of days mines operated | Percent of county or State total mined by stripping | Man-days of labor | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Steam | Electric | All others | Mined by stripping | Total at same mines | Underground | Surface | | Total | | | | |
| | | | | | | | | In strip pits | All others | | | | | |
| Alabama: Blount and Walker | 5 | 10 | ------- | 2 | 52,154 | 54,101 | 2 | 157 | 20 | 179 | 81 | [1] 2.0 | 14,430 | 3.75 |
| Illinois: | | | | | | | | | | | | | | |
| Bureau, Henry, Jackson, Jefferson, Knox, Randolph, and Schuyler | 7 | ------- | 10 | 1 | 1,167,785 | 1,167,785 | ------- | 275 | 246 | 521 | 158 | 32.7 | 82,071 | 14.23 |
| Fulton | 9 | ------- | 16 | 4 | 2,051,372 | 2,051,372 | ------- | 271 | 270 | 541 | 206 | 77.1 | 111,231 | 18.44 |
| Grundy | 5 | ------- | ------- | 5 | 87,196 | 87,196 | ------- | 76 | 16 | 92 | 94 | 53.9 | 8,602 | 10.14 |
| La Salle | 13 | ------- | 1 | 12 | 204,850 | 204,850 | ------- | 132 | 49 | 181 | 157 | 36.6 | 28,346 | 7.23 |
| Perry | 4 | 3 | 16 | 1 | 2,411,133 | 2,411,133 | ------- | 488 | 226 | 714 | 207 | 71.9 | 147,674 | 16.33 |
| St. Clair | 5 | ------- | 2 | 7 | 384,053 | 384,053 | ------- | 61 | 44 | 105 | 167 | 13.2 | 17,584 | 21.84 |
| Saline | 4 | 2 | 4 | 1 | 455,367 | 455,367 | ------- | 133 | 66 | 199 | 136 | 12.4 | 27,150 | 16.77 |
| Vermilion | 3 | 2 | ------- | 3 | 144,508 | 144,508 | ------- | 62 | 20 | 82 | 163 | 6.2 | 13,383 | 10.80 |
| Will | 3 | ------- | 10 | 6 | 1,483,027 | 1,483,027 | ------- | 292 | 158 | 450 | 243 | 100.0 | 109,193 | 13.58 |
| Williamson | 9 | 1 | 3 | 7 | 723,378 | 723,378 | ------- | 119 | 84 | 203 | 187 | 24.6 | 37,958 | 19.06 |
| Total Illinois | 62 | 8 | 62 | 47 | 9,112,669 | 9,112,669 | ------- | 1,909 | 1,179 | 3,088 | 189 | 17.9 | 583,192 | 15.63 |
| Indiana: | | | | | | | | | | | | | | |
| Clay | 23 | 14 | 4 | 24 | 888,936 | 888,936 | ------- | 414 | 163 | 577 | 155 | 82.5 | 89,244 | 9.96 |
| Fountain, Knox, and Owen | 6 | 2 | 1 | 8 | 231,746 | 231,746 | ------- | 117 | 27 | 144 | 175 | 10.4 | 25,262 | 9.17 |
| Greene | 14 | 10 | 6 | 6 | 1,135,194 | 1,135,194 | ------- | 335 | 167 | 502 | 144 | 61.3 | 72,115 | 15.74 |
| Pike | 7 | 4 | 12 | 6 | 2,842,070 | 2,842,070 | ------- | 574 | 284 | 858 | 193 | 91.0 | 165,935 | 17.13 |
| Sullivan | 4 | 4 | 3 | 5 | 454,156 | 454,156 | ------- | 132 | 95 | 227 | 142 | 20.2 | 32,145 | 14.13 |
| Vigo | 5 | 3 | 4 | 1 | 1,101,071 | 1,101,071 | ------- | 364 | 134 | 498 | 218 | 30.9 | 108,510 | 10.15 |
| Warrick | 6 | 2 | 4 | 9 | 1,026,628 | 1,026,628 | ------- | 215 | 143 | 358 | 210 | 78.7 | 75,168 | 13.66 |
| Total Indiana | 65 | 39 | 34 | 59 | 7,679,801 | 7,679,801 | ------- | 2,151 | 1,013 | 3,164 | 180 | 43.1 | 568,379 | 13.51 |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Iowa: | | | | | | | | | | | | | | |
| Davis, Greene, Keokuk, Van Buren, Warren, and Webster | 10 | 1 | 2 | 5 | 80,864 | 80,864 | ---- | 82 | 25 | 107 | 119 | 29.0 | 12,779 | 6.33 |
| Mahaska | 7 | ---- | ---- | 8 | 87,477 | 87,477 | ---- | 76 | 15 | 91 | 113 | 57.4 | 10,259 | 8.53 |
| Marion | 8 | ---- | ---- | 7 | 104,193 | 104,193 | ---- | 69 | 14 | 83 | 173 | 28.4 | 14,320 | 7.28 |
| Total Iowa | 25 | 1 | 2 | 20 | 272,534 | 272,534 | ---- | 227 | 54 | 281 | 133 | [3]34.2 | 37,358 | 7.30 |
| Kansas: | | | | | | | | | | | | | | |
| Bourbon | 6 | 3 | ---- | 2 | 23,998 | 23,998 | ---- | 33 | 7 | 40 | 161 | 100.0 | 6,420 | 3.74 |
| Cherokee | 3 | 1 | 2 | 1 | 268,938 | 268,938 | ---- | 67 | 34 | 101 | 154 | 80.7 | 15,600 | 17.24 |
| Coffey, Franklin, and Linn | 5 | ---- | ---- | 4 | 17,123 | 17,123 | ---- | 46 | 9 | 55 | 96 | 33.0 | 5,299 | 3.23 |
| Crawford | 24 | 20 | 11 | 5 | 1,689,037 | 1,689,037 | ---- | 636 | 173 | 809 | 166 | 72.1 | 134,614 | 12.55 |
| Labette | 5 | 2 | ---- | 3 | 14,494 | 14,494 | ---- | 24 | 5 | 29 | 139 | 100.0 | 4,042 | 3.59 |
| Osage | 12 | ---- | ---- | 2 | 12,124 | 12,124 | ---- | 80 | 15 | 95 | 68 | 13.5 | 6,457 | 1.88 |
| Total Kansas | 55 | 26 | 13 | 17 | 2,025,714 | 2,025,714 | ---- | 886 | 243 | 1,129 | 153 | 68.8 | 172,432 | 11.75 |
| Missouri: | | | | | | | | | | | | | | |
| Barton | 7 | 4 | 7 | 2 | 745,475 | 745,475 | ---- | 160 | 63 | 223 | 197 | 98.9 | 43,836 | 17.01 |
| Bates | 3 | 4 | 4 | 1 | 708,944 | 708,944 | ---- | 178 | 96 | 274 | 175 | 97.2 | 47,819 | 14.83 |
| Boone, Callaway, Dade, Jasper, Johnson, Randolph, and Warren | 8 | 3 | 3 | 5 | 381,980 | 381,980 | ---- | 113 | 26 | 139 | 202 | 61.0 | 28,033 | 13.63 |
| Henry | 6 | 6 | 5 | ---- | 538,473 | 538,473 | ---- | 218 | 63 | 281 | 173 | 95.9 | 48,696 | 11.06 |
| Vernon | 3 | 3 | 1 | ---- | 85,877 | 85,877 | ---- | 44 | 11 | 55 | 220 | 70.5 | 12,094 | 7.10 |
| Total Missouri | 27 | 20 | 20 | 8 | 2,460,749 | 2,460,749 | ---- | 713 | 259 | 972 | 186 | 61.8 | 180,478 | 13.63 |
| Montana: | | | | | | | | | | | | | | |
| Montana and Texas lignite | 4 | 2 | 2 | 1 | 87,227 | 87,227 | ---- | 34 | 1 | 35 | 113 | [2]11.5 | 3,942 | 22.13 |
| Rosebud | 1 | ---- | 2 | 1 | 1,225,468 | 1,225,468 | ---- | 41 | 12 | 53 | 303 | 99.9 | 16,059 | 76.31 |
| Total Montana [3] | 5 | 2 | 4 | 2 | 1,312,695 | 1,312,695 | ---- | 75 | 13 | 88 | 227 | [4]34.6 | 20,001 | 65.63 |
| North Dakota: Lignite | 55 | 9 | 7 | 10 | 1,366,921 | 1,371,239 | 3 | 408 | 117 | 528 | 212 | 61.7 | 111,910 | 12.25 |
| Ohio: | | | | | | | | | | | | | | |
| Carroll, Coshocton, Hocking, Holmes, Muskingum, Vinton, and Wayne | 7 | 3 | 2 | 7 | 248,077 | 257,681 | 15 | 133 | 34 | 182 | 173 | 15.3 | 31,571 | 8.16 |
| Columbiana | 7 | 3 | ---- | 9 | 248,478 | 248,478 | ---- | 116 | 37 | 153 | 195 | 58.5 | 29,900 | 8.31 |
| Harrison | 4 | 13 | ---- | 1 | 639,173 | 639,173 | ---- | 204 | 81 | 285 | 192 | 23.5 | 54,650 | 11.70 |
| Jackson | 6 | 5 | ---- | 6 | 122,381 | 129,786 | 13 | 78 | 20 | 111 | 142 | 44.0 | 15,789 | 8.22 |
| Jefferson | 3 | 7 | 2 | 1 | 862,334 | 862,334 | ---- | 180 | 67 | 247 | 266 | 20.5 | 65,596 | 13.15 |
| Perry | 3 | 1 | ---- | 2 | 124,697 | 124,697 | ---- | 56 | 16 | 72 | 205 | 13.6 | 14,740 | 8.46 |
| Stark | 7 | 6 | ---- | 9 | 183,884 | 190,604 | 7 | 80 | 14 | 101 | 249 | 28.1 | 25,166 | 7.57 |
| Tuscarawas | 8 | 3 | ---- | 6 | 29,092 | 34,943 | 4 | 49 | 6 | 59 | 106 | 2.3 | 6,250 | 5.59 |
| Total Ohio | 45 | 41 | 4 | 41 | 2,458,116 | 2,487,696 | 39 | 896 | 275 | 1,210 | 201 | [1]20.4 | 243,662 | 10.21 |

See footnotes at end of table.

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TABLE 14.—*Stripping operations of all types in bituminous-coal fields in 1936, by States and counties*—Continued

| State and county | Number of strip pits | Number of power shovels | | | Coal produced (net tons) | | Number of employees | | | | Average number of days mines operated | Percent of county or State total mined by stripping | Man-days of labor | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Steam | Electric | All others | Mined by stripping | Total at same mines | Underground | Surface | | Total | | | | |
| | | | | | | | | In strip pits | All others | | | | | |
| Oklahoma: Haskell, Rogers, and Wagoner | 5 | 6 | 2 | ------- | 343,598 | 343,598 | ------- | 153 | 25 | 178 | 162 | 22.3 | 28,921 | 11.88 |
| Pennsylvania: Beaver, Butler, Cambria, Clarion, Clearfield, Clinton, Elk, Fayette, Lycoming, McKean, Tioga, Washington, and Westmoreland | 18 | 20 | ------- | 10 | 753,784 | 1,442,549 | 584 | 294 | 224 | 1,102 | 222 | [1] 1.1 | 244,847 | 5.89 |
| South Dakota: Lignite | 4 | ------- | ------- | 4 | 33,517 | 33,517 | ------- | 24 | 5 | 29 | 280 | 81.1 | 8,110 | 4.13 |
| Wyoming: Campbell, Carbon, and Converse | 4 | ------- | 2 | 2 | 142,694 | 152,938 | 5 | 37 | 17 | 59 | 268 | [1] 19.6 | 15,806 | 9.68 |
| Other States [5] | 6 | 6 | 1 | 1 | 110,911 | 474,934 | 342 | 113 | 88 | 543 | 166 | [1].9 | 90,329 | 5.26 |
| Total United States | 381 | 188 | 151 | 223 | 28,125,857 | 29,224,734 | 975 | 8,043 | 3,532 | 12,550 | 185 | 6.4 | 2,319,855 | 12.60 |

[1] Percent of county totals, not State.
[2] Percent of total Texas and Montana lignite.
[3] Includes Texas lignite.
[4] Percent of total Texas and Montana lignite and Montana bituminous.
[5] Arkansas, Colorado, Kentucky, and West Virginia.

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TABLE 15.—*Summary of operations of power strip pits proper in the bituminous-coal fields in 1936, by States*

| State | Number of strip pits | Number of power shovels | | | Amount mined by stripping [1] (net tons) | Number of men employed [2] | Average number of days mines operated [2] | Average tons per man per day [2] |
|---|---|---|---|---|---|---|---|---|
| | | Steam | Electric | All others | | | | |
| Power strip pits proper: | | | | | | | | |
| Alabama | 4 | 9 | | 2 | 46,406 | 168 | 69 | 4.03 |
| Illinois | 49 | 8 | 62 | 47 | 9,091,844 | 3,030 | 191 | 15.72 |
| Indiana | 62 | 39 | 34 | 59 | 7,665,333 | 3,143 | 180 | 13.53 |
| Iowa | 18 | 1 | 2 | 20 | 251,744 | 232 | 137 | 7.92 |
| Kansas | 38 | 26 | 13 | 17 | 2,001,246 | 1,015 | 161 | 12.28 |
| Missouri | 25 | 20 | 20 | 8 | 2,457,849 | 961 | 187 | 13.68 |
| Montana (bituminous) | 1 | | 2 | 1 | 1,225,468 | 53 | 303 | 76.31 |
| Montana, North Dakota, South Dakota, and Texas (lignite) [3] | 15 | 11 | 9 | 15 | 1,423,486 | 447 | 237 | 13.51 |
| Ohio | 37 | 36 | 4 | 38 | 2,415,940 | 1,123 | 200 | 10.74 |
| Oklahoma | 5 | 6 | 2 | | 343,598 | 178 | 162 | 11.88 |
| Pennsylvania | 11 | 13 | | 10 | 338,067 | 233 | 188 | 7.72 |
| Other States [4] | 6 | 4 | 3 | 2 | 217,720 | 156 | 164 | 8.49 |
| Total | 271 | 173 | 151 | 219 | 27,478,701 | 10,739 | 184 | 13.91 |
| Horse stripping operations | 96 | | | | 163,438 | 424 | 106 | 3.65 |
| Mines combining stripping and underground methods in same operations [5] | 14 | 15 | | 4 | 483,718 | 1,387 | 216 | 5.28 |
| Grand total | 381 | 188 | 151 | 223 | 28,125,857 | 12,550 | 185 | 12.60 |

[1] Exclusive of coal produced by underground mining in the same operation.
[2] Items in these columns include underground mining conducted in the same operation.
[3] Includes one mine in North Dakota which has both underground and strip mining in the same operation.
[4] Arkansas, Colorado, Kentucky, and Wyoming.
[5] Includes operations in Alabama, Kentucky, Ohio, Pennsylvania, and Wyoming, in which the output was obtained by both methods. In addition to the 483,718 tons produced by stripping this group of 14 mines obtained 1,094,559 tons by underground methods, its total production by both methods being 1,578,277 tons.

TABLE 16.—*Stripping operations of all types in bituminous-coal fields in 1937, by States and counties*

| State and county | Number of strip pits | Coal produced (net tons) | | Number of men employed [1] | Average number of days mines operated [1] | Average tons per man per day [1] |
|---|---|---|---|---|---|---|
| | | Mined by stripping | Total at same mines [1] | | | |
| Alabama: Blount and Walker | 4 | 36,268 | 38,041 | 199 | 69 | 2.75 |
| Arkansas: Franklin and Sebastian | 5 | 28,472 | 28,472 | 39 | 106 | 6.88 |
| Illinois: | | | | | | |
| Adams, Brown, Edgar, Henry, Jackson, Knox, Randolph, Vermilion, and Will | 12 | 3,827,854 | 3,827,854 | 1,210 | 226 | 13.99 |
| Fulton | 9 | 2,671,871 | 2,671,871 | 700 | 187 | 20.44 |
| Grundy | 4 | 101,488 | 101,488 | 105 | 72 | 13.47 |
| LaSalle | 11 | 223,439 | 223,439 | 190 | 130 | 9.03 |
| Perry | 4 | 2,787,746 | 2,787,746 | 694 | 195 | 20.63 |
| St. Clair | 6 | 449,233 | 449,233 | 124 | 160 | 22.61 |
| Saline | 4 | 783,268 | 783,268 | 196 | 187 | 21.37 |
| Williamson | 8 | 603,833 | 603,833 | 192 | 156 | 20.21 |
| Total Illinois | 58 | 11,448,732 | 11,448,732 | 3,411 | 193 | 17.40 |
| Indiana: | | | | | | |
| Clay | 25 | 1,095,698 | 1,095,698 | 647 | 170 | 9.95 |
| Fountain | 4 | 31,795 | 31,795 | 36 | 145 | 6.11 |
| Greene | 15 | 1,457,367 | 1,457,367 | 648 | 154 | 14.61 |
| Owen | 6 | 159,835 | 159,835 | 99 | 155 | 10.45 |
| Pike | 9 | 2,953,423 | 2,953,423 | 879 | 207 | 16.25 |
| Spencer and Vermillion | 3 | 42,595 | 42,595 | 69 | 58 | 10.70 |
| Sullivan | 6 | 461,569 | 461,569 | 237 | 116 | 16.79 |
| Vigo | 6 | 1,002,046 | 1,002,046 | 248 | 229 | 17.67 |
| Warrick | 5 | 1,076,674 | 1,076,674 | 324 | 224 | 14.84 |
| Total Indiana | 79 | 8,281,002 | 8,281,002 | 3,187 | 180 | 14.46 |

See footnotes at end of table.

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TABLE 16.—*Stripping operations of all types in bituminous-coal fields in 1937, by States and counties*—Continued

| State and county | Number of strip pits | Coal produced (net tons) | | Number of men employed [1] | Average number of days mines operated [1] | Average tons per man per day [1] |
|---|---|---|---|---|---|---|
| | | Mined by stripping | Total at same mines [1] | | | |
| Iowa: | | | | | | |
| Davis, Greene, Keokuk, Monroe, Wapello, Warren, and Webster | 11 | 98,881 | 98,881 | 134 | 113 | 6.56 |
| Mahaska | 8 | 171,308 | 171,308 | 111 | 174 | 8.85 |
| Marion | 14 | 142,954 | 142,954 | 139 | 151 | 6.81 |
| Van Buren | 3 | 5,808 | 5,808 | 12 | 142 | 3.40 |
| Total Iowa | 36 | 418,951 | 418,951 | 396 | 144 | 7.33 |
| Kansas: | | | | | | |
| Bourbon | 6 | 63,289 | 63,289 | 99 | 104 | 6.12 |
| Cherokee | 4 | 263,573 | 263,573 | 121 | 142 | 15.29 |
| Crawford | 24 | 1,598,956 | 1,598,956 | 752 | 167 | 12.71 |
| Labette | 4 | 16,443 | 16,443 | 29 | 156 | 3.63 |
| Linn and Neosho | 5 | 17,249 | 17,249 | 26 | 167 | 3.98 |
| Osage | 6 | 7,141 | 7,141 | 30 | 100 | 2.37 |
| Total Kansas | 49 | 1,966,651 | 1,966,651 | 1,057 | 156 | 11.90 |
| Missouri: | | | | | | |
| Barton | 7 | 504,962 | 504,962 | 185 | 180 | 15.16 |
| Bates | 4 | 670,397 | 670,397 | 282 | 167 | 14.23 |
| Boone, Dade, Jasper, Johnson, Macon, Ralls, Randolph, and Warren | 11 | 712,021 | 712,021 | 306 | 184 | 12.67 |
| Callaway | 3 | 78,627 | 78,627 | 53 | 269 | 5.51 |
| Henry | 7 | 599,981 | 599,981 | 311 | 195 | 9.87 |
| Vernon | 6 | 88,179 | 88,179 | 88 | 166 | 6.05 |
| Total, Missouri | 38 | 2,654,167 | 2,654,167 | 1,225 | 185 | 11.73 |
| Montana: (Montana and Texas lignite) | 4 | 88,574 | 88,574 | 34 | 115 | 22.67 |
| Rosebud | 1 | 1,247,337 | 1,247,337 | 63 | 258 | 76.70 |
| Total Montana [2] | 5 | 1,335,911 | 1,335,911 | 97 | 208 | 66.24 |
| North Dakota: (Lignite) | 72 | 1,347,355 | 1,348,615 | 582 | 177 | 13.13 |
| Ohio: | | | | | | |
| Carroll | 3 | 26,060 | 26,060 | 23 | 138 | 8.23 |
| Columbiana | 12 | 218,822 | 218,822 | 118 | 185 | 10.01 |
| Coshocton, Hocking, Holmes, Lawrence, Mahoning, Perry, Vinton, and Wayne | 12 | 285,181 | 299,706 | 191 | 204 | 7.68 |
| Harrison | 4 | 521,371 | 521,371 | 232 | 174 | 12.88 |
| Jackson | 6 | 75,456 | 81,026 | 93 | 134 | 6.50 |
| Jefferson | 8 | 1,003,327 | 1,003,327 | 296 | 241 | 14.07 |
| Muskingum | 3 | 71,732 | 71,732 | 117 | 75 | 8.20 |
| Stark | 8 | 196,338 | 203,230 | 106 | 255 | 7.53 |
| Tuscarawas | 12 | 70,337 | 77,355 | 71 | 181 | 6.03 |
| Total Ohio | 68 | 2,468,624 | 2,502,629 | 1,247 | 190 | 10.57 |
| Oklahoma: | | | | | | |
| Haskell, Muskogee, and Wagoner | 6 | 432,842 | 432,842 | 256 | 133 | 12.75 |
| Rogers | 3 | 33,093 | 33,093 | 16 | 206 | 10.06 |
| Total Oklahoma | 9 | 465,935 | 465,935 | 272 | 137 | 12.51 |
| Pennsylvania: Allegheny, Beaver Butler, Cambria, Clarion, Clearfield, Fayette, Lycoming, Tioga, Washington, and Westmoreland | 12 | 853,944 | 1,111,296 | 588 | 232 | 8.15 |
| South Dakota (Lignite) | 4 | 42,094 | 42,094 | 27 | 213 | 7.33 |
| Wyoming: Campbell, Carbon, and Converse | 5 | 167,799 | 183,978 | 74 | 260 | 9.55 |
| Other States [3] | 5 | 234,948 | 248,083 | 192 | 117 | 11.02 |
| Total United States | 449 | 31,750,853 | 32,074,557 | 12,593 | 181 | 14.08 |

[1] Items in these columns include underground mining conducted in the same operation.
[2] Includes Texas lignite.
[3] Colorado, Kentucky, and West Virginia.

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## UNDERCUTTING MACHINES IN 1936

TABLE 17.—*Number of coal-cutting machines in bituminous-coal mines, average output per machine, and percentage of total product of underground mines cut by machines in 1936, by States* [1]

| State | Number of coal-cutting machines in use | | | Average output per machine (net tons) | Percent of total product of underground mines cut by machines |
|---|---|---|---|---|---|
| | "Permissible" | All others [2] | Total | | |
| Alabama | 69 | 276 | 345 | 25,688 | 72.8 |
| Arkansas | 54 | 95 | 149 | 8,538 | 81.2 |
| Colorado | 105 | 286 | 391 | 11,914 | 68.6 |
| Illinois | 345 | 940 | 1,285 | 28,760 | 88.4 |
| Indiana | 92 | 223 | 315 | 29,071 | 90.3 |
| Iowa | 64 | 49 | 113 | 11,649 | 35.7 |
| Kansas | 17 | 10 | 27 | 9,628 | 28.3 |
| Kentucky | 382 | 1,034 | 1,416 | 31,420 | 93.7 |
| Maryland | 16 | 22 | 38 | 15,960 | 35.6 |
| Michigan | 9 | 46 | 55 | 11,192 | 98.3 |
| Missouri | 48 | 44 | 92 | 9,703 | 58.6 |
| Montana and Texas | 17 | 39 | 56 | 29,181 | 64.9 |
| New Mexico | 29 | 16 | 45 | 9,172 | 25.8 |
| North Dakota | 20 | 5 | 25 | 23,070 | 68.0 |
| Ohio | 297 | 655 | 952 | 21,512 | 94.6 |
| Oklahoma | 64 | 46 | 110 | 8,530 | 78.4 |
| Pennsylvania | 2,247 | 1,125 | 3,372 | 24,868 | 76.9 |
| Tennessee | 27 | 85 | 112 | 31,940 | 70.0 |
| Utah | 53 | 67 | 120 | 23,635 | 87.4 |
| Virginia | 59 | 194 | 253 | 41,564 | 90.2 |
| Washington | 30 | 6 | 36 | 18,074 | 35.9 |
| West Virginia | 991 | 1,412 | 2,403 | 45,127 | 92.0 |
| Wyoming | 45 | 217 | 262 | 20,322 | 94.5 |
| Other States | | 2 | 2 | 1,583 | 20.6 |
| Total United States | 5,080 | 6,894 | 11,974 | 29,091 | 84.8 |

[1] Similar data for 1937 are not available.
[2] Probably includes some "permissible" machines not so specified by the operators.

## LOADING MACHINES AND CONVEYORS IN 1936, AND SALES IN 1937 AND 1938

*Mechanical loading in 1936 and 1937.*—The data for mechanical loading refer to all devices designed to reduce the labor of hand shoveling into mine cars. Data for 1936 are based on complete returns courteously furnished by coal operators. Figures for 1937 are preliminary and are based on various sources, as indicated in the footnotes to table 18.

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TABLE 18.—*Bituminous coal mechanically loaded, 1935–37, by States, in net tons*

| State | 1935 [1] | 1936 | 1937 (preliminary) |
|---|---|---|---|
| Alabama | 1,303,653 | 1,741,452 | [2] 2,100,000 |
| Arkansas | 292,064 | 522,411 | [3] 550,000 |
| Colorado | 197,319 | 557,548 | [3] 1,018,039 |
| Illinois | 20,513,082 | 26,110,068 | [4] 28,344,362 |
| Indiana | 5,767,696 | 7,146,090 | [5] 7,426,306 |
| Iowa | | ([6]) | ([6]) |
| Kentucky | 533,250 | 658,747 | [2] 1,300,000 |
| Maryland | ([6]) | ([6]) | ([6]) |
| Missouri | ([6]) | | |
| Montana | 1,291,373 | 1,464,121 | [2] 1,431,000 |
| New Mexico | ([6]) | ([6]) | ([6]) |
| North Dakota | ([6]) | ([6]) | ([6]) |
| Ohio | 1,488,303 | 2,049,075 | [7] 3,204,102 |
| Oklahoma | ([6]) | ([6]) | ([6]) |
| Pennsylvania | 6,469,485 | 9,033,855 | [8] 11,951,639 |
| Tennessee | 233,579 | 290,220 | [2] 450,000 |
| Utah | 898,118 | 1,358,543 | [2] 1,835,000 |
| Virginia | 651,807 | 779,232 | [2] 1,500,000 |
| Washington | 429,617 | 608,488 | [9] 838,000 |
| West Virginia | 2,059,322 | 8,712,935 | [10] 15,490,863 |
| Wyoming | 4,530,032 | 5,189,263 | [11] 5,300,000 |
| Undistributed | 518,524 | 754,824 | 760,689 |
| Total United States | 47,177,224 | 66,976,872 | 83,500,000 |

[1] Bureau of Mines Minerals Yearbook, 1937, pp. 832, 887.
[2] Estimated on the basis of sales of new equipment in 1937.
[3] Thomas Allen, State inspector of coal mines, Colorado.
[4] James McSherry, director, Department of Mines and Minerals, Illinois.
[5] Jonas Waffle, managing director, Coal Trade Association of Indiana.
[6] Included in "Undistributed." Data for 1937 are based largely on telegraphic reports from operators.
[7] Milan W. Hranilovich, Division of Labor Statistics, Department of Industrial Relations, Ohio.
[8] M. J. Hartneady, Secretary of Mines, Pennsylvania.
[9] Telegraphic reports from mine operators.
[10] N. P. Rhinehart, chief, Department of Mines, West Virginia.
[11] Hugh McLeod, State mine inspector, Wyoming.

TABLE 19.—*Bituminous coal mechanically loaded underground in 1936, by types of machines*

| | Net tons | Percent |
|---|---|---|
| Loaded by machine: | | |
| Mobile loading machines | 40,969,625 | 90.1 |
| Scraper loaders | 1,272,466 | 2.8 |
| Conveyors equipped with duckbills and other self-loading devices | 3,240,411 | 7.1 |
| Total loaded by machine | 45,482,502 | 100.0 |
| Handled by conveyors: | | |
| Conveyors equipped with duckbills and other self-loading devices | 3,240,411 | 13.1 |
| Pit-car loaders | 10,538,331 | 42.6 |
| Hand-loaded conveyors | 10,956,039 | 44.3 |
| Total handled by conveyors | 24,734,781 | 100.0 |
| Recapitulation, less duplications: | | |
| Mobile loading machines | 40,969,625 | 61.2 |
| Scraper loaders | 1,272,466 | 1.9 |
| Conveyors equipped with duckbills and other self-loading devices | 3,240,411 | 4.8 |
| Pit-car loaders | 10,538,331 | 15.7 |
| Hand-loaded conveyors | 10,956,039 | 16.4 |
| Grand total loaded mechanically | 66,976,872 | 100.0 |

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TABLE 20.—*Comparative change in tonnage of bituminous coal loaded by principal types of machines, 1935–36*

| | 1935 (net tons) | 1936 (net tons) | Increase or decrease in 1936 | |
|---|---|---|---|---|
| | | | Net tons | Percent |
| Mobile loading machines | 24,675,248 | 40,969,625 | +16,294,377 | +66.0 |
| Scraper loaders | 1,118,201 | 1,272,466 | +154,265 | +13.8 |
| Duckbills and other self-loading conveyors | 2,594,564 | 3,240,411 | +645,847 | +24.9 |
| Total loaded by machines | 28,388,013 | 45,482,502 | +17,094,489 | +60.2 |
| Pit-car loaders | 11,098,466 | 10,538,331 | −560,135 | −5.0 |
| Other hand-loaded conveyors | 7,690,745 | 10,956,039 | +3,265,294 | +42.5 |
| Grand total | 47,177,224 | 66,976,872 | +19,799,648 | +42.0 |

TABLE 21.—*Percent of State output of deep-mined bituminous coal mechanically loaded in each State, 1933–36, by classes of equipment*

| State | Percent of underground production loaded by machines in each State [1] | | | | Percent of underground production handled by conveyors in each State [2] | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1933 | 1934 | 1935 | 1936 | 1933 | 1934 | 1935 | 1936 | 1933 | 1934 | 1935 | 1936 |
| Alabama | 2.0 | 1.6 | 3.4 | 4.4 | 14.0 | 10.2 | 12.0 | 9.9 | 16.0 | 11.8 | 15.4 | 14.3 |
| Arkansas | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | 17.0 | 25.1 | 26.6 | 33.3 |
| Colorado | .7 | (3) | 1.6 | 5.1 | .7 | (3) | 1.7 | 3.1 | 1.4 | 1.3 | 3.3 | 8.2 |
| Illinois | 32.6 | 33.1 | 34.5 | 44.5 | 21.3 | 19.5 | 20.8 | 17.9 | 53.9 | 52.6 | 55.3 | 62.4 |
| Indiana | 36.2 | 47.7 | 54.0 | 63.1 | 12.4 | 13.7 | 8.5 | 7.3 | 48.6 | 61.4 | 62.5 | 70.5 |
| Iowa | ------ | ------ | ------ | ------ | (3) | ------ | ------ | (3) | (3) | ------ | ------ | (3) |
| Kentucky | (3) | (3) | (3) | .2 | (3) | (3) | (3) | 1.2 | 2.2 | 1.9 | 1.3 | 1.4 |
| Maryland | ------ | ------ | ------ | ------ | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) |
| Missouri | ------ | ------ | ------ | ------ | (3) | (3) | (3) | ------ | (3) | (3) | (3) | ------ |
| Montana | 66.8 | 60.4 | 59.5 | 70.4 | 12.7 | 18.7 | 20.6 | 12.8 | 79.5 | 79.1 | 80.1 | 83.2 |
| New Mexico | (3) | (3) | (3) | (3) | ------ | ------ | ------ | ------ | (3) | (3) | (3) | (3) |
| North Dakota | ------ | (3) | (3) | (3) | ------ | ------ | ------ | ------ | ------ | (3) | (3) | (3) |
| Ohio | (3) | 5.8 | 7.8 | 9.2 | (3) | ------ | ------ | .2 | 5.5 | 5.8 | 7.8 | 9.5 |
| Oklahoma | ------ | (3) | (3) | (3) | ------ | ------ | ------ | ------ | ------ | (3) | (3) | (3) |
| Pennsylvania | 1.8 | 1.5 | 1.5 | 3.2 | 6.7 | 5.8 | 5.6 | 5.1 | 8.5 | 7.3 | 7.1 | 8.3 |
| Tennessee | (3) | (3) | 2.1 | 1.8 | (3) | (3) | 3.5 | 3.9 | (3) | (3) | 5.6 | 5.7 |
| Utah | (3) | 23.5 | 28.4 | 38.5 | (3) | 1.4 | 2.1 | 3.4 | 20.6 | 24.9 | 30.5 | 41.8 |
| Virginia | ------ | ------ | (3) | 1.4 | 4.5 | 4.1 | (3) | 5.3 | 4.5 | 4.1 | 6.7 | 6.7 |
| Washington | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | 19.4 | 24.6 | 27.6 | 33.6 |
| West Virginia | .4 | .7 | 1.2 | 5.4 | .4 | .7 | .9 | 2.0 | .8 | 1.4 | 2.1 | 7.4 |
| Wyoming | 60.3 | 69.6 | 74.8 | 76.5 | 15.5 | 14.5 | 15.0 | 15.5 | 75.8 | 84.1 | 89.8 | 92.0 |
| Undistributed | (4) | (4) | (4) | (4) | (4) | (4) | (4) | (4) | (4) | (4) | (4) | (4) |
| United States total | 6.5 | 7.0 | 8.1 | 11.1 | 5.5 | 5.2 | 5.4 | 5.2 | 12.0 | 12.2 | 13.5 | 16.3 |

[1] Includes mobile loaders, scrapers, and duckbills.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Concealed to avoid disclosing results of individual operations.
[4] Not calculated because figures are not comparable from year to year.

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## TABLE 22.—*Mechanical loading underground in bituminous-coal mines in 1936, by States*

[The table includes all soft-coal mines that produced any part of their tonnage with the aid of mechanical loading devices in 1936. The mines have been grouped into three classes. The first includes those mines in which all of the tonnage mechanically loaded was obtained with machines that substantially eliminate hand shoveling; that is, mobile loaders, scrapers, and duckbill-equipped conveyors. It should be noted, however, that some of these mines make use of conveyors in conjunction with mobile loaders to perform the initial phase of transportation. The second class includes those mines in which all the tonnage mechanically loaded was obtained with hand-loaded conveyors or pit-car loaders. The third class includes mines that load with both types of machines]

| State | Number of mines | | | | Number of machines | | | | | Production mechanically loaded (net tons) | | | Total production of mechanized mines (net tons) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Using loading machines only [1] | Using conveyors only [2] | Using both loading machines and conveyors | Total | Mobile loading machines | Scrapers | Conveyors equipped with duckbills and other self-loading devices | Pit-car loaders | Installations of hand-loaded conveyors [3] | Loaded by machines [1] | Handled by conveyors [2] | Total | Mines using loading machines only [1] | Mines using conveyors only [2] | Mines using both loading machines and conveyors | Total |
| Alabama | 8 | 13 | 6 | 27 | 10 | 27 | 5 | (4) | 15 | 541,005 | 1,200,447 | 1,741,452 | 2,292,173 | 2,079,844 | 849,168 | 5,221,185 |
| Arkansas | 2 | 15 | | 17 | | (4) | | | 15 | (4) | (4) | 522,411 | (4) | (4) | | 558,485 |
| Colorado | 9 | 7 | 1 | 17 | (4) | | 25 | | 8 | 344,598 | 212,950 | 557,548 | (4) | 1,018,727 | (4) | 1,929,977 |
| Illinois | 36 | 14 | 16 | 66 | 431 | | | 1,151 | 1 | 18,607,302 | 7,502,766 | 26,110,068 | 14,125,730 | 6,114,091 | 10,129,258 | 30,369,079 |
| Indiana | 19 | 8 | 5 | 32 | 146 | | | 74 | 2 | 6,402,957 | 743,133 | 7,146,090 | 5,870,010 | 582,887 | 1,012,779 | 7,465,676 |
| Iowa | | 2 | | 2 | | | | | 2 | | (4) | (4) | | (4) | | (4) |
| Kentucky | 3 | 10 | 3 | 16 | (4) | (4) | (4) | (4) | 10 | 85,012 | 573,735 | 658,747 | (4) | 1,644,211 | (4) | 5,094,373 |
| Maryland | | 3 | | 3 | | | | | 3 | | (4) | (4) | | (4) | | (4) |
| Montana | 3 | | 3 | 6 | 31 | | (4) | 32 | | 1,239,069 | 225,052 | 1,464,121 | 817,216 | | 746,297 | 1,563,513 |
| New Mexico | 2 | | | 2 | (4) | (4) | | | | (4) | | (4) | (4) | | | (4) |
| North Dakota | 2 | | | 2 | (4) | | | | | (4) | | (4) | (4) | | | (4) |
| Ohio | 14 | 6 | | 20 | 47 | | (4) | | 6 | 2,002,526 | 46,549 | 2,049,075 | 5,613,823 | 872,307 | | 6,486,130 |
| Oklahoma | 1 | | | 1 | | (4) | | | | (4) | | (4) | (4) | | | (4) |
| Pennsylvania | 18 | 41 | 11 | 70 | 92 | 31 | (4) | (4) | 43 | 3,455,323 | 5,578,532 | 9,033,855 | 7,263,015 | 10,966,131 | 7,077,456 | 25,306,602 |
| Tennessee | 1 | 1 | 2 | 4 | (4) | (4) | (4) | | 3 | 91,975 | 198,245 | 290,220 | (4) | (4) | (4) | 824,700 |
| Utah | 7 | 3 | 1 | 11 | 43 | | | (4) | 4 | 1,248,483 | 110,060 | 1,358,543 | (4) | (4) | (4) | 2,180,400 |
| Virginia | 5 | 6 | | 11 | 9 | | | | 6 | 150,884 | 619,348 | 770,232 | 298,540 | 1,793,592 | | 2,092,132 |
| Washington | 1 | 4 | | 5 | | | (4) | | 4 | (4) | (4) | 608,488 | (4) | (4) | | 651,053 |
| West Virginia | 43 | 53 | 4 | 100 | 126 | (4) | | | 57 | 6,334,220 | 2,378,715 | 8,712,935 | 16,762,116 | 11,146,894 | 1,257,291 | 29,166,301 |
| Wyoming | 10 | 6 | 8 | 24 | 24 | (4) | 175 | 66 | 6 | 4,313,885 | 875,378 | 5,189,263 | 2,174,568 | 678,710 | 2,519,219 | 5,372,497 |
| Undistributed | | | | | 21 | 48 | 29 | 528 | | 656,263 | 1,229,460 | 754,824 | 3,808,821 | 2,589,848 | 3,864,035 | 1,686,654 |
| Total: | | | | | | | | | | | | | | | | |
| 1936 | 184 | 192 | 60 | 436 | 980 | 106 | 234 | 1,851 | 185 | 45,482,502 | 21,494,370 | 66,976,872 | 59,026,012 | 39,487,242 | 27,455,503 | 125,968,757 |
| 1935 | 113 | 158 | 46 | 317 | 657 | 78 | 180 | 2,098 | 135 | 28,388,013 | 18,789,211 | 47,177,224 | 33,040,992 | 34,933,922 | 18,545,116 | 86,520,030 |
| Percent change in 1936 | +62.8 | +21.5 | +30.4 | +37.5 | +49.2 | +35.9 | +30.0 | −11.8 | +37.0 | +60.2 | +14.4 | +42.0 | +78.6 | +13.0 | +48.0 | +45.6 |

[1] Includes mobile loading machines, scrapers, and conveyors equipped with duckbills and other self-loading heads. Some mines in this class also use conveyors in conjunction with mobile loaders to perform the initial phase of transportation.

[2] Includes hand-loaded conveyors and pit-car loaders.

[3] Number of mines in which hand-loaded conveyors (other than pit-car loaders) were used.

[4] Included under "Undistributed" to avoid disclosing individual operations.

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TABLE 23.—*Comparative changes in mechanical loading by principal types of machines, 1935–36, by States, in net tons*

| State | 1935 | | | 1936 | | | Increase or decrease in 1936 | | | | | | Percent handled by each class | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Quantity | | | Percent | | | 1935 | | 1936 | |
| | Loaded by machines [1] | Handled by conveyors [2] | Total | Loaded by machines [1] | Handled by conveyors [2] | Total | Loaded by machines [1] | Handled by conveyors [2] | Total | Loaded by machines | Handled by conveyors | Total | Loaded by machines | Handled by conveyors | Loaded by machines | Handled by conveyors |
| Alabama | 286,483 | 1,017,170 | 1,303,653 | 541,005 | 1,200,447 | 1,741,452 | +254,522 | +183,277 | +437,799 | +88.8 | +18.0 | +33.6 | [3] 22.0 | 78.0 | [3] 31.1 | 68.9 |
| Arkansas | (4) | (4) | 292,064 | (4) | (4) | 522,411 | (4) | (4) | +230,347 | (4) | (4) | +78.9 | (4) | (4) | (4) | (4) |
| Colorado | 97,269 | 100,050 | 197,319 | 344,598 | 212,950 | 557,548 | +247,329 | +112,900 | +360,229 | +254.3 | +112.8 | +182.6 | [5] 49.3 | [6] 50.7 | 61.8 | 38.2 |
| Illinois | 12,809,739 | 7,703,343 | 20,513,082 | 18,607,302 | 7,502,766 | 26,110,068 | +5,797,563 | −200,577 | +5,596,986 | +45.3 | −2.6 | +27.3 | [7] 62.4 | [8] 37.6 | [7] 71.3 | [8] 28.7 |
| Indiana | 4,986,408 | 781,288 | 5,767,696 | 6,402,957 | 743,133 | 7,146,090 | +1,416,549 | −38,155 | +1,378,394 | +28.4 | −4.9 | +23.9 | [7] 86.5 | [9] 13.5 | [7] 89.6 | [9] 10.4 |
| Iowa | | | | | (4) | (4) | | (4) | (4) | | (4) | (4) | | | | 100.0 |
| Kentucky | (4) | (4) | 533,250 | 85,012 | 573,735 | 658,747 | (4) | (4) | +125,497 | (4) | (4) | +23.5 | (4) | (4) | [5] 12.9 | 87.1 |
| Maryland | | (4) | (4) | | (4) | (4) | | (4) | (4) | | (4) | (4) | | 100.0 | (4) | 100.0 |
| Missouri | | (4) | (4) | | | | | (4) | (4) | | (4) | (4) | | 100.0 | | |
| Montana | 959,596 | 331,777 | 1,291,373 | 1,239,069 | 225,052 | 1,464,121 | +279,473 | −106,725 | +172,748 | +29.1 | −32.2 | +13.4 | [5] 74.3 | [10] 25.7 | [5] 84.6 | [10] 15.4 |
| New Mexico | (4) | | (4) | (4) | | (4) | (4) | | (4) | (4) | | (4) | 100.0 | | 100.0 | |
| North Dakota | (4) | | (4) | (4) | | (4) | (4) | | (4) | (4) | | (4) | [7] 100.0 | | [7] 100.0 | |
| Ohio | 1,488,303 | | 1,488,303 | 2,002,526 | 46,549 | 2,049,075 | +514,223 | +46,549 | +560,772 | +34.6 | +100.0 | +37.7 | [7] 100.0 | | [11] 97.7 | [6] 2.3 |
| Oklahoma | (4) | | (4) | (4) | | (4) | (4) | | (4) | (4) | | (4) | 100.0 | | 100.0 | |
| Pennsylvania | 1,387,241 | 5,082,244 | 6,469,485 | 3,455,323 | 5,578,532 | 9,033,855 | +2,068,082 | +496,288 | +2,564,370 | +149.1 | +9.8 | +39.6 | [5] 21.4 | 78.6 | [5] 38.2 | 61.8 |
| Tennessee | 87,898 | 145,681 | 233,579 | 91,975 | 198,245 | 290,220 | +4,077 | +52,564 | +56,641 | +4.6 | +36.1 | +24.2 | 37.6 | [6] 62.4 | 31.7 | [6] 68.3 |
| Utah | 836,574 | 61,544 | 898,118 | 1,248,483 | 110,060 | 1,358,543 | +411,909 | +48,516 | +460,425 | +49.2 | +78.8 | +51.3 | [7] 93.1 | 6.9 | [7] 91.9 | 8.1 |
| Virginia | (4) | (4) | 651,807 | 159,884 | 619,348 | 779,232 | (4) | (4) | +127,425 | (4) | (4) | +19.5 | (4) | (4) | [7] 20.5 | [6] 79.5 |
| Washington | (4) | (4) | 429,617 | (4) | (4) | 608,488 | (4) | (4) | +178,871 | (4) | (4) | +41.6 | (4) | (4) | (4) | (4) |
| West Virginia | 1,197,119 | 862,203 | 2,059,322 | 6,334,220 | 2,378,715 | 8,712,935 | +5,137,101 | +1,516,512 | +6,653,613 | +429.1 | +175.9 | +323.1 | [5] 58.1 | [6] 41.9 | [11] 72.7 | [6] 27.3 |
| Wyoming | 3,774,960 | 755,072 | 4,530,032 | 4,313,885 | 875,378 | 5,189,263 | +538,925 | +120,306 | +659,231 | +14.3 | +15.9 | +14.6 | 83.3 | 16.7 | 83.1 | 16.9 |
| Undistributed | 476,423 | 1,948,839 | 518,524 | 656,263 | 1,229,460 | 754,824 | [12] | [12] | [12] | [12] | [12] | [12] | [12] | [12] | [12] | [12] |
| | 28,388,013 | 18,789,211 | 47,177,224 | 45,482,502 | 21,494,370 | 66,976,872 | +17,094,489 | +2,705,159 | +19,799,648 | +60.2 | +14.4 | +42.0 | 60.2 | 39.8 | 67.9 | 32.1 |

[1] Includes mobile loaders, scrapers, duckbills, and other self-loading conveyors.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Principally by scrapers.
[4] Included under "Undistributed" to avoid disclosing individual operations.
[5] Principally by mobile loaders.
[6] Entirely by conveyors.
[7] Entirely by mobile loaders.
[8] Practically all by pit-car loaders.
[9] Principally by pit-car loaders.
[10] Entirely by pit-car loaders.
[11] Practically all by mobile loaders.
[12] Included in total; tons loaded and percentage by types not given because State groups are not comparable in 1935 and 1936.



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*Sales of mechanical loading equipment in 1937 and 1938.*—The trend of mechanization since 1936 is indicated by manufacturers' sales of equipment. Figure 7 shows the relative amount of coal mechanically loaded in 1936 in each producing State, together with the approximate capacity of new equipment installed in 1937 and 1938. The chart therefore affords a rough measure of the mechanical loading capacity available at the beginning of 1939, by States. Tables 24 and 25 give the details of sales.

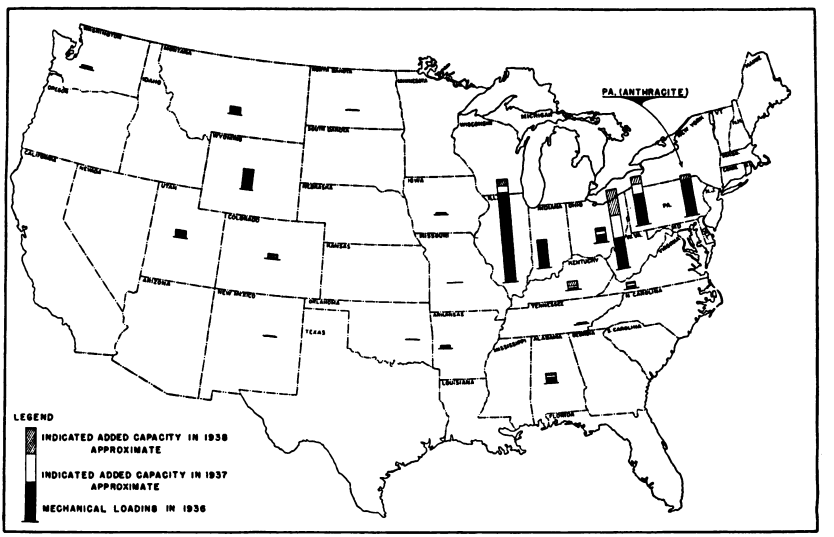


FIGURE 7.—Bituminous coal mechanically loaded in 1936 and approximate capacity of new equipment shipped in 1937 and 1938.

TABLE 24.—*Sales of mechanized loading equipment in 1937 and 1938 compared with total number of machines in active use in preceding years*

| | Number of machines in active use, as reported by mine operators | | | | | | | | Number of machines sold as reported by 29 manufacturers | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 |
| Mobile loading machines | 488 | 545 | 583 | 548 | 523 | 534 | 657 | 980 | 292 | 241 |
| Scrapers | 126 | 150 | 146 | 128 | 93 | 119 | 78 | 106 | 13 | 6 |
| Pit-car loaders | 2,521 | 2,876 | 3,428 | 3,112 | 2,453 | 2,288 | 2,098 | 1,851 | 32 | 139 |
| Conveyors equipped with duckbills and other self-loading heads | 99 | 140 | 165 | 159 | 132 | 157 | 179 | 234 | [2] 835 | 749 |
| Hand-loaded conveyors—number of units | (1) | (1) | (1) | (1) | 525 | 574 | 670 | 936 | | |

[1] Number of units not reported in these years.
[2] Reported as face conveyors (hand-loaded), "shaker drives," and "duckbills." The figures of numbers sold in 1937 and 1938 are not exactly comparable with the number in use in 1936, because of uncertainties in defining what constitutes a conveyor.

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TABLE 25.—*Comparison of mobile loaders, scrapers, and conveyors in actual use in bituminous-coal mines in 1936 with sales reported in 1937 and 1938, by regions*

| | Mobile loaders | | | Scrapers | | | Conveyors [1] | | |
|---|---|---|---|---|---|---|---|---|---|
| | In use, 1936 | Sales | | In use, 1936 | Sales | | In use, 1936 | Sales | |
| | | 1937 | 1938 | | 1937 | 1938 | | 1937 | 1938 |
| Northern Appalachian States: | | | | | | | | | |
| Pennsylvania | 92 | 23 | 47 | 31 | | | 366 | 105 | 52 |
| Maryland | | | | | | | | | |
| Ohio | 47 | 28 | 15 | | | | 18 | 37 | 23 |
| Southern Appalachian States: | | | | | | | | | |
| Alabama | 10 | 7 | | 27 | 5 | 2 | 64 | 64 | 64 |
| Kentucky | 5 | 18 | [2] 39 | | | | 35 | 106 | 98 |
| Tennessee | | 1 | | 11 | 1 | | 21 | 38 | 20 |
| West Virginia | 126 | 73 | 80 | | 5 | 3 | 196 | 275 | 332 |
| Virginia | [3] 9 | 8 | 9 | | 1 | | 70 | 16 | 5 |
| Middle Western States: | | | | | | | | | |
| Illinois | 431 | 81 | [3] 38 | | | | 7 | 19 | 20 |
| Indiana | 146 | 31 | | | | | | | |
| Trans-Mississippi States | [4] 114 | [5] 22 | [6] 13 | [7] 37 | [8] 1 | 1 | [9] 393 | [10] 175 | [11] 135 |
| | 980 | 292 | 241 | 106 | 13 | 6 | 1,170 | 835 | 749 |

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads. The figures of number in use in 1936 are not exactly comparable with the number sold in 1937 and 1938 because of uncertainties in defining what constitutes a conveyor. The comparison, however, will serve to indicate which regions have made the largest proportionate increases.
[2] Mostly in Kentucky.
[3] Mostly in Illinois.
[4] Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming.
[5] Arkansas, Montana, Utah, and Wyoming.
[6] Colorado, Montana, Oklahoma, Utah, and Wyoming.
[7] Arkansas, New Mexico, Oklahoma, and Wyoming.
[8] Wyoming.
[9] Arkansas, Colorado, Iowa, Montana, Utah, Washington, and Wyoming.
[10] Arkansas, Colorado, Iowa, Utah, and Wyoming.
[11] Arkansas, Colorado, Iowa, Oklahoma, Utah, and Wyoming.

## POWER DRILLING IN UNDERGROUND MINES IN 1936

In 1936, a total of 111,950,000 tons (27.2 percent) of the deep-mined bituminous-coal output was produced from working places in which the shot holes were drilled by mechanical power drills as contrasted with hand drills. Power drills are in use or on trial in nearly every important coal-producing county. In some counties the production by power drills is substantial; in others it is insignificant. The conditions under which this kind of labor-saving device is used differ widely, not only geographically but also as to thickness of beds, pitch of seams, and hardness of the coal itself. The widespread acceptance of this mechanical tool under varying conditions indicates an extensive market for drilling machinery, since three-fourths of the Nation's production of bituminous coal is still hand-drilled. The application of power drills is another step toward substitution of mechanical devices for hand labor.

The amount of bituminous coal produced by the use of electric drills amounted to 100,050,000 tons and by compressed-air drills 11,900,000, a total of 111,950,000 tons. More than 88 percent of the total produced by compressed-air drills came from Western Pennsylvania.

For details by States showing tons produced by the two types of drills, percentage power-drilled compared with machine cutting and mechanical loading, and total production of mines using one or more

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drills in coal or rock or both, see "A Reconnaissance of Power Drilling in Underground Bituminous-Coal Mines in 1936," by J. J. Gallagher and L. N. Plein in Mining Congress Journal, January 1939, pages 26–28; also National Bituminous Coal Commission Weekly Coal Report 1118, December 17, 1938.

## MECHANICAL CLEANING IN 1936

Data on mechanical cleaning of coal in 1936 are given in tables 26 to 31. Although figures for 1937 and 1938 are not available reports from manufacturers of mechanical cleaning equipment indicate that a large number of new installations were made in these years.

TABLE 26.—*Bituminous coal mechanically cleaned by wet and pneumatic methods, 1935–36, in net tons of clean coal*

| | 1935 | 1936 | Increase in 1936 | |
|---|---|---|---|---|
| | | | Net tons | Percent |
| By wet methods: | | | | |
| At the mines | 31,006,643 | 42,795,529 | +11,788,886 | +38.0 |
| At central washeries operated by consumers | 5,849,845 | 7,708,499 | +1,858,654 | +31.8 |
| Total wet | 36,856,488 | 50,504,028 | +13,647,540 | +37.0 |
| By pneumatic methods | 8,504,533 | 10,590,948 | +2,086,415 | +24.5 |
| Grand total | 45,361,021 | 61,094,976 | +15,733,955 | +34.7 |

TABLE 27.—*Bituminous coal cleaned, 1935–36, by classes of equipment in actual operation*

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania are included.]

| Type of equipment | Plants in operation | | Net tons of clean coal | | Increase in 1936 | | Percent cleaned by each type | |
|---|---|---|---|---|---|---|---|---|
| | 1935 | 1936 | 1935 | 1936 | Net tons | Percent | 1935 | 1936 |
| Wet methods: | | | | | | | | |
| Jigs | 138 | 154 | 15,735,039 | 23,417,266 | +7,682,227 | +48.8 | 34.7 | 38.3 |
| Concentrating tables [1] | 9 | 8 | 1,117,789 | 1,843,167 | +725,378 | +64.9 | 2.5 | 3.0 |
| Jigs in combination with concentrating tables [1] | 15 | 16 | 1,549.422 | 2,612,666 | +1,063,244 | +68.6 | 3.4 | 4.3 |
| Launders and upward-current classifiers | 93 | 98 | 18,454,238 | 22,630,929 | +4,176,691 | +22.6 | 40.7 | 37.1 |
| Total wet | 255 | 276 | 36,856,488 | 50,504,028 | +13,647,540 | +37.0 | 81.3 | 82.7 |
| Pneumatic methods | 65 | 66 | 8,504,533 | 10,590,948 | +2,086,415 | +24.5 | 18.7 | 17.3 |
| Grand total | [2] 320 | [2] 342 | 45,361,021 | 61,094,976 | +15,733,955 | +34.7 | 100.0 | 100.0 |

[1] A more representative figure for the use of wet tables is indicated by combining the totals for concentrating tables with the total for jigs in combination with concentrating tables. This shows a net gain of 1,788,622 tons (67.1 percent) for 1936.

[2] Plants using both wet and pneumatic types—32 in 1935; 31 in 1936.

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TABLE 28.—*Total production of all coal at mines with cleaning plants, 1935–36, in net tons*

[Does not include any estimate for mines that may ship to consumer-operated plants]

| | 1935 | 1936 | Increase or decrease in 1936 | |
|---|---|---|---|---|
| | | | Net tons | Percent |
| Wet methods: | | | | |
| Jigs | 34,892,156 | 48,975,308 | +14,083,152 | +40.4 |
| Concentrating tables | 1,490,635 | 1,194,635 | −296,000 | −19.9 |
| Jigs in combination with concentrating tables | 1,771,351 | 2,791,533 | +1,020,182 | +57.6 |
| Launders and upward-current classifiers | 37,768,410 | 47,943,815 | +10,175,405 | +26.9 |
| Total wet | 75,922,552 | 100,905,291 | +24,982,739 | +32.9 |
| Pneumatic methods | 24,030,553 | 29,974,961 | +5,944,408 | +24.7 |
| Grand total | 99,953,105 | 130,880,252 | +30,927,147 | +30.9 |
| Less duplication [1] | 12,786,859 | 15,478,035 | +2,691,176 | +21.0 |
| Net Total | 87,166,246 | 115,402,217 | +28,235,971 | +32.4 |
| United States production of bituminous coal | 372,373,122 | 439,087,903 | +66,714,781 | +17.9 |
| Percent produced at mines with cleaning plants | 23.4 | 26.3 | | |

[1] Mines using both wet and pneumatic methods.

TABLE 29.—*Bituminous coal mechanically cleaned by wet and pneumatic methods, 1935–36, by States*

[Coal cleaned at central washeries operated by consumers in Colorado and Pennsylvania is included]

| State | Clean coal in net tons | | Increase or decrease in 1936 | | Percent of State output mechanically cleaned | |
|---|---|---|---|---|---|---|
| | 1935 | 1936 | Net tons | Percent | 1935 | 1936 |
| Alabama | 6,841,269 | 9,922,514 | +3,081,245 | +45.0 | 80.4 | 81.1 |
| Colorado | 492,874 | 713,678 | +220,804 | +44.8 | 8.3 | 10.5 |
| Illinois | 3,154,128 | 5,613,522 | +2,459,394 | +78.0 | 7.1 | 11.0 |
| Indiana | 1,283,555 | 2,198,067 | +914,512 | +71.2 | 8.2 | 12.3 |
| Kentucky | 351,568 | 514,647 | +163,079 | +46.4 | .9 | 1.1 |
| Missouri and Kansas | 1,169,351 | 1,771,870 | +602,519 | +51.5 | 18.5 | 25.5 |
| Ohio and Michigan | 1,151,546 | 1,331,545 | +179,999 | +15.6 | 5.3 | 5.4 |
| Pennsylvania | 17,844,642 | 21,584,403 | +3,739,761 | +21.0 | 19.5 | 19.6 |
| Tennessee | 341,117 | 257,987 | −83,130 | −24.4 | 8.3 | 5.1 |
| Virginia | 389,548 | 473,992 | +84,444 | +21.7 | 4.0 | 4.1 |
| Washington | 614,771 | 1,203,783 | +589,012 | +95.8 | 39.4 | 66.4 |
| West Virginia | 11,613,813 | 15,360,671 | +3,746,858 | +32.2 | 11.7 | 13.0 |
| Other States [1] | 112,839 | 148,297 | +35,458 | +31.4 | ------ | ------ |
| | 45,361,021 | 61,094,976 | +15,733,955 | +34.7 | 12.2 | 13.9 |

[1] Arkansas, Maryland, Montana, and New Mexico.

TABLE 30.—*Method of mining at mines served by cleaning plants, 1934–36*

| Method of mining in use | Total production of mines with cleaning plants | | | Increase in 1936 | |
|---|---|---|---|---|---|
| | 1934 | 1935 | 1936 | Net tons | Percent |
| Mined from strip pits | 7,127,710 | 9,314,425 | 10,952,733 | +1,638,308 | +17.6 |
| Mechanically loaded underground | 10,128,745 | 15,065,777 | 23,461,832 | +8,396,055 | +55.7 |
| Hand-loaded underground | 59,052,707 | 62,786,044 | 80,987,652 | +18,201,608 | +29.0 |
| | 76,309,162 | 87,166,246 | 115,402,217 | +28,235,971 | +32.4 |

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*Relation between raw coal, clean coal, and refuse.*—For every 100 tons of raw coal that passed into the cleaning systems about 90.5 tons came out as clean, merchantable product, and about 9.5 tons went to the refuse bank as worthless. Figures as to the amount of refuse resulting from cleaning operations seldom have been published, for several reasons: many mine operators cannot furnish exact figures, and the nature of the seam, the methods of mining, and the specific gravity at which the separation is made affect the percentage of refuse. With these factors in mind table 31 is offered as an indicator of the percentage of refuse resulting from mechanical cleaning in the various States.

TABLE 31.—*Relation between total production, raw coal, and refuse resulting from cleaning operations in 1936, by States, in net tons*

| State | Total production of mines with cleaning plants | Result of cleaning operations | | | Percent of refuse to raw coal | Percent of clean coal to total mine production |
|---|---|---|---|---|---|---|
| | | Raw coal | Clean coal | Refuse | | |
| Alabama | 11,135,961 | 11,119,454 | 9,922,514 | 1,196,940 | 10.8 | 89.1 |
| Colorado | (1) | (1) | (1) | (1) | 8.5 | 26.6 |
| Illinois | 17,191,716 | 6,675,210 | 5,613,522 | 1,061,688 | 15.9 | 32.7 |
| Indiana | 4,848,150 | 2,556,083 | 2,198,067 | 358,016 | 14.0 | 45.3 |
| Kentucky | 2,495,819 | 564,875 | 514,647 | 50,228 | 8.9 | 20.6 |
| Missouri and Kansas | 2,349,664 | 2,053,539 | 1,771,870 | 281,669 | 13.7 | 75.4 |
| Ohio and Michigan | 2,880,574 | 1,536,329 | 1,331,545 | 204,784 | 13.3 | 46.2 |
| Pennsylvania | (1) | (1) | (1) | (1) | 6.9 | 53.0 |
| Tennessee | 551,737 | 305,947 | 257,987 | 47,960 | 15.7 | 46.8 |
| Virginia | 1,853,615 | 551,211 | 473,992 | 77,219 | 14.0 | 25.6 |
| Washington | 1,502,214 | 1,429,682 | 1,203,783 | 225,899 | 15.8 | 80.1 |
| West Virginia | 42,034,038 | 16,408,308 | 15,360,671 | 1,047,637 | 6.4 | 36.5 |
| Undistributed [2] | 28,558,729 | 15,832,849 | 14,737,879 | 1,094,970 | 5.5 | 22.0 |
| Total at mines only | 115,402,217 | 59,033,487 | 53,386,477 | 5,647,010 | 9.6 | 46.3 |
| Consumer plants | | 8,128,518 | 7,708,499 | 420,019 | 5.2 | |
| Grand total | | 67,162,005 | 61,094,976 | 6,067,029 | 9.0 | |

[1] Included in "Undistributed."
[2] Tonnage figures include Arkansas, Colorado, Maryland, Montana, New Mexico, and Pennsylvania. Percentage figures represent results for Arkansas, Maryland, Montana, and New Mexico only.

## SIZES PRODUCED

Complete statistics of the tonnage of each size of bituminous coal shipped in 1937 are given in the following publications of the Coal Commission, based on the distribution survey:

Key Table of Sizes and of Size Groups Proposed by District Boards in Western Districts; December 12, 1938.
Key Table of Sizes and of Size Groups Proposed by District Boards in Eastern Districts; January 4, 1939.
Key Table of Sizes and of Size Groups Proposed by District Boards in Middle Western Districts; January 4, 1939.

These tables give for the first time accurate data on the number and comparative importance of the manifold sizes in which bituminous coal is prepared for the market at present.

The analysis shows that in District 7 of the coal act no less than 117 different sizes were prepared and marketed in 1937. In some districts a still greater diversity of sizes was recorded.

Copies of these tables may be had on application to the United States Department of the Interior, Washington, D. C.

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## FUEL EFFICIENCY

TABLE 32.—*Indicators of the effect of fuel economy on consumption of coal per unit of performance since the World War*

| | Pounds | Reduction from base period (percent) |
|---|---|---|
| Steam railroads: | | |
| Pounds per 1,000 gross ton-miles freight service: | | |
| Average, 1919–20 | 170 | |
| Average, 1937 | 117 | 31.2 |
| Average, 1938 | 115 | 32.4 |
| Pounds per passenger-train car-mile: | | |
| Average, 1919–20 | 18.5 | |
| Average, 1937 | 15.1 | 18.4 |
| Average, 1938 | 14.9 | 19.5 |
| Electric-public-utility power plants: | | |
| Pounds per kilowatt-hour, 1919 | 3.2 | |
| Pounds per kilowatt-hour, 1937 | 1.4 | 56.2 |
| Pounds per kilowatt-hour, 1938 | 1.4 | 56.2 |
| Iron and steel—pounds coking coal per ton of pig: [1] | | |
| 1918 | 3,577 | |
| 1937 | 2,917 | 18.5 |
| 1938 | 2,865 | 19.9 |
| Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913–38, expressed as percent of coal used for all coke in 1938 [2] | | 18.2 |

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron. Excludes economies through recovery of byproducts, which are treated in next item.

[2] These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

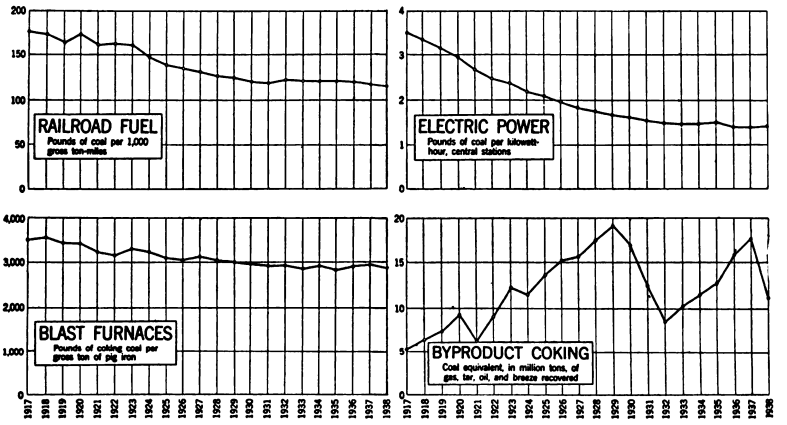
RAILROAD FUEL
Pounds of coal per 1,000 gross ton-miles
ELECTRIC POWER
Pounds of coal per kilowatt-hour, central stations
BLAST FURNACES
Pounds of coking coal per gross ton of pig iron
BYPRODUCT COKING
Coal equivalent, in million tons, of gas, tar, oil, and breeze recovered

FIGURE 8.—Trends in fuel efficiency in the United States, 1917–38.

## DISTRIBUTION

Tables showing the movement of coal to the Great Lakes, tidewater, New England, and certain other major channels of distribution are included in the Monthly Coal Distribution Reports.

Details of distribution by sizes and grade from each origin district to each consuming market area are being published by the Divisions of Research and Statistics, National Bituminous Coal Commission.

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## STOCKS HELD BY CONSUMERS

TABLE 33.—*Stocks of bituminous coal in hands of commercial consumers and of anthracite and bituminous coal in retail dealers' yards, 1937–38*

| Date | Total stock of bituminous coal estimated (net tons) | Days' supply at current rate of consumption on date of stock taking | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | By-product coke plants | Steel plants | Other industrials | Coal-gas plants | Electric utilities | Retail yards, bituminous | Railroads | Total bituminous | Retail yards, anthracite |
| 1937 | | | | | | | | | | |
| Jan. 1 | 42,926,000 | 42 | 31 | 29 | 58 | 59 | 25 | 26 | 31 | 38 |
| Feb. 1 | 43,390,000 | 40 | 35 | 29 | 54 | 65 | 22 | 28 | 31 | 37 |
| Mar. 1 | 46,574,000 | 42 | 37 | 28 | 52 | 69 | 22 | 31 | 32 | 26 |
| Apr. 1 | 53,153,000 | 46 | 43 | 33 | 58 | 75 | 22 | 41 | 37 | 24 |
| May 1 | 46,921,000 | 41 | 43 | 32 | 53 | 77 | 32 | 33 | 38 | 31 |
| June 1 | 45,169,000 | 39 | 43 | 36 | 55 | 80 | 66 | 32 | 42 | 49 |
| July 1 | 43,936,000 | 40 | 47 | 37 | 60 | 72 | 61 | 35 | 43 | 93 |
| Aug. 1 | 43,371,000 | 37 | 44 | 41 | 61 | 69 | 66 | 33 | 43 | 122 |
| Sept. 1 | 43,851,000 | 36 | 40 | 42 | 59 | 66 | 59 | 33 | 42 | 71 |
| Oct. 1 | 46,032,000 | 37 | 39 | 44 | 66 | 69 | 39 | 30 | 41 | 51 |
| Nov. 1 | 47,986,000 | 44 | 43 | 43 | 65 | 73 | 40 | 27 | 41 | 65 |
| Dec. 1 | 48,280,000 | 53 | 45 | 42 | 75 | 78 | 37 | 29 | 43 | 50 |
| Dec. 31 | 47,074,000 | 56 | 44 | 42 | 61 | 79 | 25 | 32 | 40 | 36 |
| 1938 | | | | | | | | | | |
| Jan. 1 | 47,074,000 | 56 | 44 | 42 | 61 | 79 | 25 | 32 | 40 | 36 |
| Feb. 1 | 41,967,000 | 51 | 41 | 37 | 53 | 82 | 22 | 28 | 37 | 27 |
| Mar. 1 | 38,484,000 | 46 | 35 | 33 | 51 | 83 | 22 | 28 | 35 | 26 |
| Apr. 1 | 35,359,000 | 43 | 33 | 33 | 51 | 87 | 22 | 28 | 36 | 25 |
| May 1 | 34,102,000 | 43 | 36 | 35 | 50 | 97 | 36 | 29 | 41 | 44 |
| June 1 | 33,158,000 | 47 | 37 | 39 | 57 | 91 | 53 | 28 | 45 | 58 |
| July 1 | 33,452,000 | 51 | 37 | 40 | 63 | 85 | 64 | 27 | 46 | 57 |
| Aug. 1 | 33,615,000 | 54 | 35 | 43 | 68 | 81 | 69 | 26 | 47 | 58 |
| Sept. 1 | 34,579,000 | 49 | 31 | 41 | 68 | 73 | 52 | 25 | 43 | 63 |
| Oct. 1 | 36,507,000 | 47 | 29 | 42 | 61 | 72 | 39 | 24 | 41 | 44 |
| Nov. 1 | 39,024,000 | 46 | 26 | 42 | 60 | 71 | 40 | 24 | 40 | 59 |
| Dec. 1 | 40,817,000 | 47 | 24 | 39 | 57 | 71 | 34 | 24 | 38 | 51 |
| Dec. 31 | 40,720,000 | 49 | 25 | 35 | 54 | 71 | 25 | 24 | 35 | 37 |

## IMPORTS AND EXPORTS[5]

TABLE 34.—*Bituminous coal*[1] *imported for consumption in the United States, 1937–38, by countries and customs districts, in net tons*

| | 1937 | 1938 | | 1937 | 1938 |
|---|---|---|---|---|---|
| *Country* | | | *District*—Continued | | |
| North America: Canada | 252,147 | 240,729 | Los Angeles | | 1,131 |
| Europe: | | | Maine and New Hampshire | 92,718 | 88,314 |
| France | | 437 | Maryland | 232 | |
| United Kingdom | 5,513 | 139 | Michigan | 153 | |
| Asia: Japan | 336 | | Montana-Idaho | 104,381 | 95,511 |
| | | | New Orleans | | 437 |
| | 257,996 | 241,305 | Oregon | 340 | |
| | | | St. Lawrence | | 242 |
| *District* | | | Vermont | 1,312 | 2,313 |
| | | | Virgin Islands | 5,282 | 139 |
| Alaska | 10,781 | 11,634 | Washington | 42,050 | 41,344 |
| Dakota | 520 | 162 | | | |
| Duluth and Superior | 227 | 78 | | 257,996 | 241,305 |

[1] Includes slack, culm, and lignite.

[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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TABLE 35.—*Exports of bituminous coal to Canada and Mexico, the West Indies, and Central America, and "overseas" destinations, 1931–38, in thousands of net tons*

| Year | Canada and Mexico | West Indies and Central America [1] | "Overseas" (all other countries) | | | | | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Newfoundland, Miquelon, and Bermuda | South America | Europe | Asia | Africa | Oceania | Total "overseas" | |
| 1931 | 10,647 | 755 | 98 | 306 | 246 | 18 | 56 | ------- | 724 | 12,126 |
| 1932 | 8,429 | 235 | 6 | 108 | 3 | 8 | 25 | [2] | 150 | 8,814 |
| 1933 | 8,600 | 223 | 21 | 174 | 7 | 6 | 6 | ------- | 214 | 9,037 |
| 1934 | 10,213 | 410 | 40 | 203 | ------- | 3 | ------- | ------- | 246 | 10,869 |
| 1935 | 9,044 | 456 | 31 | 197 | 9 | 5 | ------- | ------- | 242 | 9,742 |
| 1936 | 9,912 | 470 | 44 | 163 | 50 | [3] | [4] | 16 | 273 | 10,655 |
| 1937 | 12,052 | 732 | 51 | 265 | 10 | 24 | 11 | ------- | 361 | 13,145 |
| 1938 | 9,561 | 619 | 23 | 247 | 11 | 29 | ------- | ------- | 310 | 10,490 |

[1] Includes Bahamas and Panama. Virgin Islands included prior to 1935.
[2] 2 tons [3] 1 ton. [4] 3 tons.

TABLE 36.—*Bituminous coal exported from the United States, 1937–38, by countries, in net tons* [1]

| Country | 1937 | 1938 | Country | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | South America—Contd. | | |
| Bermuda | 6,873 | 5,253 | Columbia | 39 | 12 |
| British Honduras | 195 | 722 | Ecuador | 32 | 49 |
| Canada | 12,047,788 | 9,559,726 | Guiana: | | |
| Central America: | | | British | 232 | ------- |
| Costa Rica | 2 | ------- | Surinam (Netherland) | 2,831 | 4,532 |
| Guatemala | 631 | 158 | Peru | 8,492 | 2,249 |
| Honduras | 456 | 365 | Uruguay | 23,727 | 20,876 |
| Nicaragua | 123 | 26 | Venezuela | 104 | 46 |
| Panama | 130,943 | 107,961 | | 265,029 | 247,302 |
| Salvador | 27 | 76 | | | |
| Mexico | 4,323 | 991 | | | |
| Miquelon and St. Pierre Islands | 5,676 | 1 | Europe: | | |
| Newfoundland and Labrador | 38,341 | 17,703 | Belgium | 3,787 | ------- |
| West Indies: | | | France | 1,921 | 11,192 |
| British: | | | Netherlands | 2,881 | ------- |
| Barbados | ------- | 609 | United Kingdom | 696 | [2] |
| Jamaica | 104,152 | 83,637 | | 9,285 | 11,192 |
| Trinidad and Tobago | 67,131 | 42,779 | | | |
| Other British | 34,011 | 19,206 | Asia: | | |
| Cuba | 371,180 | 347,565 | Ceylon | 9,356 | ------- |
| Dominican Republic | 93 | 74 | China | 1,341 | 21,363 |
| French | 19,958 | 13,241 | Iran | ------- | 6 |
| Haiti | ------- | 28 | Japan | 211 | ------- |
| Netherlands | 3,537 | 3,218 | Netherland India | 9,116 | 7,067 |
| | | | Philippine Islands | 3,707 | ------- |
| | 12,835,440 | 10,203,339 | | 23,731 | 28,436 |
| South America: | | | Africa: Algeria | 11,193 | ------- |
| Argentina | 19,617 | 15,193 | | 11,193 | ------- |
| Bolivia | 36 | 51 | | | |
| Brazil | 209,766 | 204,294 | Grand total | 13,144,678 | 10,490,269 |
| Chile | 153 | ------- | | | |

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade which aggregated 1,831,650 tons in 1937, and 1,352,480 tons in 1938.
[2] Less than 1 ton.

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TABLE 37.—*Bituminous coal exported from the United States, 1937–38, by customs districts, in net tons*

| District | 1937 | 1938 | District | 1937 | 1938 |
|---|---|---|---|---|---|
| North Atlantic: | | | Pacific Coast—Continued. | | |
| Maine and New Hampshire | 339 | 189 | San Francisco | 75 | 21,382 |
| Massachusetts | | 2 | Washington | 3,293 | 4,845 |
| New York | 14,661 | 3,397 | Northern border: | | |
| Philadelphia | 11,323 | 9,116 | Buffalo | 1,162,807 | 605,487 |
| South Atlantic: | | | Chicago | 18 | |
| Maryland | 62,013 | 45,171 | Dakota | 7,468 | 7,159 |
| South Carolina | 65,788 | 77,267 | Duluth and Superior | 48,446 | 30,783 |
| Virginia | 964,608 | 781,287 | Michigan | 1,247,994 | 1,048,498 |
| Gulf Coast: | | | Montana-Idaho | 73 | 263 |
| Florida | 632 | 14 | Ohio | 8,057,839 | 6,513,272 |
| Mobile | 2,967 | 1,318 | Rochester | 1,113,742 | 1,042,924 |
| New Orleans | 1,950 | 1,649 | St. Lawrence | 374,694 | 295,341 |
| Mexican border: | | | Vermont | 181 | 122 |
| Arizona | 310 | 280 | Wisconsin | | 112 |
| El Paso | 3,266 | 253 | Miscellaneous: | | |
| San Antonio | 53 | 31 | Alaska | 65 | 26 |
| Pacific Coast: | | | Puerto Rico | 5 | 2 |
| Los Angeles | 8 | 2 | Virgin Islands | 24 | 1 |
| San Diego | 36 | 76 | | 13,144,678 | 10,490,269 |

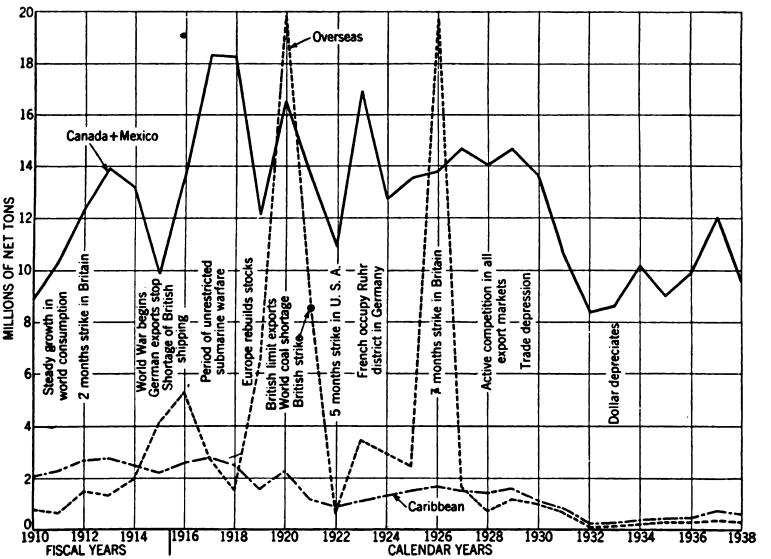


FIGURE 9.—Exports of bituminous coal to Canada and Mexico, the Caribbean, and "overseas" destinations, 1910–38.

*Shipments to Alaska, Hawaii, Puerto Rico, and the Virgin Islands.*—In addition to export trade proper the United States supplies a small tonnage of anthracite and bituminous coal to Alaska, Hawaii, Puerto Rico, and the Virgin Islands. Shipments of bituminous coal to each of these possessions in 1938 were as follows: Alaska, 23,465 net tons; Hawaii, 773; Puerto Rico, 19,967; and Virgin Islands, 93,065. Comparative shipments for 1937 were: Alaska, 24,562 net tons; Hawaii, 8,238; Puerto Rico, 20,465; and Virgin Islands, 68,359.

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## WORLD PRODUCTION

TABLE 38.—*World production of coal and lignite, 1934–38, by countries, in thousands of metric tons*

[Compiled by R. B. Miller, Bureau of Mines]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | | | |
| Canada: | | | | | |
| Coal | 9,613 | 9,358 | 10,308 | 11,014 | 9,778 |
| Lignite | 2,916 | 3,241 | 3,508 | 3,352 | 3,148 |
| Greenland | 6 | 6 | 5 | 6 | (1) |
| Mexico | 631 | 990 | 1,072 | 912 | 545 |
| United States: | | | | | |
| Anthracite | 51,862 | 47,317 | 49,513 | 46,189 | 40,872 |
| Bituminous and lignite | 326,011 | 337,809 | 393,780 | 401,386 | 310,625 |
| South America: | | | | | |
| Argentina | (1) | (1) | (1) | (1) | (1) |
| Brazil | 708 | 757 | 648 | 763 | 883 |
| Chile | 1,808 | 1,900 | 1,875 | 1,988 | 2,061 |
| Colombia | (1) | (1) | (1) | (1) | (1) |
| Peru | 35 | 85 | 90 | 99 | 115 |
| Venezuela | 6 | 6 | 6 | 7 | (1) |
| Europe: | | | | | |
| Albania: Lignite | 2 | 2 | 3 | 4 | 4 |
| Belgium | 26,389 | 26,506 | 27,867 | 29,859 | 29,575 |
| Bulgaria: | | | | | |
| Coal | 79 | 93 | 102 | 120 | 142 |
| Lignite | 1,568 | 1,566 | 1,524 | 1,732 | 1,855 |
| Czechoslovakia: | | | | | |
| Coal | 10,789 | 10,894 | 12,233 | 16,778 | 13,500 |
| Lignite | 15,071 | 15,114 | 15,949 | 17,895 | 13,100 |
| France: | | | | | |
| Coal | 47,632 | 46,213 | 45,228 | 44,319 | 46,502 |
| Lignite | 1,025 | 907 | 943 | 1,015 | 1,057 |
| Germany: [2] | | | | | |
| Coal | 124,910 | 132,379 | 146,707 | 171,148 | 171,786 |
| Lignite | 135,995 | 146,033 | 160,276 | 184,709 | 194,978 |
| Austria: | | | | | |
| Coal | 251 | 261 | 244 | 230 | 226 |
| Lignite | 2,851 | 2,971 | 2,897 | 3,242 | 3,533 |
| Saar [2] | 11,318 | 10,624 | 11,673 | 13,365 | 14,393 |
| Greece: Lignite | 104 | 83 | 106 | 131 | (1) |
| Hungary: | | | | | |
| Coal | 756 | 823 | 827 | 917 | 1,040 |
| Lignite | 6,199 | 6,718 | 7,105 | 8,055 | 8,320 |
| Irish Free State | 113 | 115 | 127 | 128 | 120 |
| Italy: | | | | | |
| Coal | 374 | 443 | 806 | 964 | 960 |
| Lignite | 409 | 545 | 769 | 1,059 | 1,327 |
| Netherlands: | | | | | |
| Coal | 12,341 | 11,878 | 12,803 | 14,321 | 13,488 |
| Lignite | 92 | 86 | 89 | 143 | 171 |
| Poland: | | | | | |
| Coal | 29,233 | 28,545 | 29,748 | 36,218 | 38,104 |
| Lignite | 26 | 18 | 14 | 19 | 10 |
| Portugal: | | | | | |
| Coal | 203 | 211 | 217 | 249 | 299 |
| Lignite | 15 | 20 | 21 | 23 | 15 |
| Rumania: | | | | | |
| Coal | 228 | 278 | 293 | 303 | (1) |
| Lignite | 1,624 | 1,667 | 1,672 | 1,879 | (1) |
| Spain: | | | | | |
| Coal | 5,932 | 7,016 | (1) | (1) | (1) |
| Lignite | 299 | 304 | (1) | (1) | (1) |
| Svalbard (Spitsbergen) | 533 | 709 | 784 | 780 | (1) |
| Sweden | 415 | 424 | 456 | 460 | (1) |
| Switzerland | 3 | 4 | 3 | 4 | 3 |
| United Kingdom: | | | | | |
| Great Britain | 224,269 | 225,816 | 232,115 | 244,268 | 223,287 |
| Northern Ireland | 1 | 4 | 5 | 1 | 1 |
| U. S. S. R.: | | | | | |
| Coal | 61,580 | 67,998 | 91,250 | 92,460 | 97,700 |
| Lignite | 4,819 | 4,820 | | | |
| Yugoslavia: | | | | | |
| Coal | 387 | 400 | 441 | 428 | 450 |
| Lignite | 3,926 | 4,028 | 4,035 | 4,574 | 5,287 |
| Asia: | | | | | |
| British Borneo | (1) | 1 | 1 | 1 | 1 |
| China | 32,725 | [4] 26,750 | 27,050 | (1) | (1) |
| Chosen | 1,689 | 1,999 | 2,282 | 2,348 | (1) |
| Federated Malay States | 327 | 383 | 511 | 638 | 486 |

See footnotes at end of table.

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TABLE 38.—*World production of coal and lignite, 1934–38, by countries, in thousands of metric tons*—Continued

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Asia—Continued. | | | | | |
| India, British | 22,971 | 23,970 | 23,548 | [4] 25,438 | (1) |
| Indochina | 1,591 | 1,775 | 2,186 | 2,308 | 2,300 |
| Iran | (1) | (1) | (1) | (1) | (1) |
| Japan: | | | | | |
| Japan proper: | | | | | |
| Coal | 35,824 | 37,674 | 41,803 | (1) | (1) |
| Lignite | 125 | 109 | 109 | (1) | (1) |
| Karafuto | 1,197 | 1,516 | 2,010 | (1) | (1) |
| Taiwan | 1,521 | 1,597 | 1,744 | (1) | (1) |
| Netherland India | 1,033 | 1,111 | 1,147 | 1,364 | 1,434 |
| Philippine Islands | (1) | (1) | (1) | (1) | (1) |
| Turkey: | | | | | |
| Coal | 2,288 | 2,340 | 2,299 | 2,307 | 2,559 |
| Lignite | 53 | 73 | 96 | 116 | (1) |
| U. S. S. R.: | | | | | |
| Coal | 20,511 | 27,242 | 32,450 | 34,540 | 35,190 |
| Lignite | 8,356 | 9,000 | | | |
| Sakhalin: Coal | 436 | (1) | | | |
| Africa: | | | | | |
| Algeria | 34 | 38 | 7 | 14 | 13 |
| Belgian Congo: Coal | 5 | 11 | 14 | 36 | (1) |
| Morocco, French | 36 | 53 | 49 | 107 | 123 |
| Nigeria | 264 | 262 | 296 | 369 | 368 |
| Portuguese East Africa | 22 | 16 | 16 | 19 | (1) |
| Southern Rhodesia | 643 | 695 | 705 | 1,029 | 1,044 |
| Union of South Africa | 12,195 | 13,574 | 14,842 | 15,491 | 16,284 |
| Oceania: | | | | | |
| Australia: | | | | | |
| New South Wales | 8,000 | 8,838 | 9,347 | 10,213 | 9,571 |
| Queensland | 972 | 1,069 | 1,064 | 1,138 | 1,131 |
| Tasmania | 115 | 126 | 134 | 93 | 85 |
| Victoria: | | | | | |
| Coal | 363 | 484 | 434 | 262 | 312 |
| Lignite | 2,660 | 2,257 | 3,094 | 3,448 | 2,718 |
| Western Australia | 508 | 546 | 574 | 562 | (1) |
| New Zealand: | | | | | |
| Coal | 845 | 838 | 873 | 986 | 2,300 |
| Lignite | 1,248 | 1,311 | 1,302 | 1,329 | |
| Total, all grades | 1,284,000 | 1,324,000 | 1,445,000 | 1,540,000 | 1,439,000 |
| Lignite (total of items shown above) | 190,000 | 204,000 | 225,000 | 256,000 | 262,000 |
| Bituminous and anthracite (by subtraction) | 1,094,000 | 1,120,000 | 1,220,000 | 1,284,000 | 1,177,000 |

[1] Estimate included in total.
[2] Exclusive of mines in the Saar.
[3] Mines under French control until Mar. 1, 1935.
[4] Production of the most important coal-producing areas.
[5] Excludes coal (about 550,000 metric tons) consumed by the miners.

## DETAILED STATISTICS, BY STATES AND COUNTIES

Detailed production and employment statistics are given in table 39 for each county in the United States in which three or more operators produced coal in 1937. If there were less than three producing companies the figures for two or more counties have been combined to avoid disclosing individual returns, unless permission to publish has been granted by the producers.

In this series the reported production is classified according to the principal channels of distribution or use. The distribution schedules (N. B. C. C. form D–1 and D–2), which constituted the primary source material for the 1937 statistics permitted a much more detailed analysis of the movement of coal from producing mines to consumer destinations than has ever been possible heretofore.

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The classifications selected for this purpose did not coincide with the groupings that had been used in the annual series for 1936 and earlier years. For purposes of presentation in this report the 1937 figures have been grouped and rearranged in the order that most nearly corresponds to the old series. The resulting data are fairly comparable, therefore, with the statistics for years prior to 1937.

The following descriptions of the classification groups have been taken very largely from the instructions on the 1937 distribution schedules. They are given here to define more clearly the limits to the various groups.

*Shipments to tidewater.*—"All coal dumped over tidewater piers."

*Shipments to Great Lakes.*—"All coal dumped over piers on Lake Erie and Lake Ontario."

*River and ex-river.*—River coal represents all bituminous "Coal moving by river barges whether loaded directly at the mine or first transported from mine to river tipple by rail or truck." Ex-river includes "Coal unloaded from river barges which is shipped inland by rail or truck to points beyond the river port of unloading." Double counting between river and ex-river has been avoided.

*All-rail other than railroad fuel.*—"All shipments (except railroad fuel) which move from mine to ultimate destination by rail, including car-ferry across Great Lakes and to Cuba." Coal reported by producers as "Shipped to distributors, destinations unknown," has also been included for convenience in the all-rail classification, although a small part of it doubtless moved by lake or tide.

*Railroad fuel, all-rail.*—"All sales of coal to railroads delivered all-rail, including coal furnished to locomotive tenders at tipple." Note that coal taken by locomotives at tipple was formerly classified with "Other sales to local trade." This item, however, is comparatively small.

*Total loaded at mines for shipment by rail or water.*—Combines the five preceding items into a total reasonably comparable with the classification in previous reports entitled "Loaded at mines for shipment by rail or water."

*Truck deliveries including local sales.*—"All coal loaded at mines for delivery by truck or wagon, including local sales." Excludes coal "used by mine employees, mine fuel and coal made into beehive coke or briquets at mine." Neither this nor the following item, "Used by mine employees," is directly comparable with individual items in the old series. If these two items are combined, however, the resulting figure is fairly comparable with the combined total for the two classifications in the old series entitled "Commercial sales by truck or wagon" and "Other sales to local trade, or used by employees, or taken by locomotives at tipple." The discrepancy between the individual groups arises from the inclusion of "Other local sales" with truck deliveries in 1937 rather than with "Coal used by mine employees," as in earlier years. Coal consumed for manufacturing or other industrial uses at the mine is responsible for the more significant shifts between the two groups.

*Used by mine employees.*—See explanatory note for "Truck deliveries, including local sales," above.

*Mine fuel or made into beehive coke at mines.*—This item is directly comparable with the former classification "Used for power and heat or made into coke at mines."

The data used in this report, like those published for many years by the Bureau of Mines, relate only to mines with an annual output of 1,000 tons or more. This fact should be borne in mind also when the statistics in this report are compared with similar data compiled by State mine departments. Differences arise in large measure from variations in coverage of the State reports, some of which include data for all mines regardless of size and others only data for mines employing more than a specified minimum number, which ranges from 2 to 10 men. Certain State reports also include washery and picking-table refuse. In the statistics here given refuse is excluded.

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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*

[Note that figures relate only to active mines of commercial size, excluding truck and wagon mines producing less than 1,000 tons. Waste and refuse are not included in tonnage. For source of data used in compiling 1937 figures and comparability with earlier years, see sections of this report on "Sources of Data and Acknowledgments" and "Detailed Statistics, by States and Counties."]

ALABAMA

| County | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | Total production, including inventory change and coal unaccounted for [3] | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel [1] | Railroad fuel all-rail [2] | Total | | | | | | | |
| Bibb | 31,052 | | | 305,676 | 191,925 | 528,653 | 7,367 | 4,758 | 12,562 | 560,728 | 1,174 | 199 | 2.40 |
| Blount | 42,990 | | | 27,369 | 26,485 | 96,844 | 30,470 | 304 | 50 | 127,668 | 403 | 161 | 1.97 |
| Cullman | | | | | | | 25,491 | | | 25,491 | 96 | 186 | 1.42 |
| Etowah | | | | | | | 11,515 | | | 11,515 | 30 | 226 | 1.70 |
| Jefferson | 70,646 | | | 6,034,464 | 1,078,126 | 7,183,236 | 137,932 | 60,290 | 69,007 | 7,438,398 | 12,739 | 217 | 2.69 |
| Marion | 1,110 | | | 235,397 | 1,129 | 237,636 | 51,890 | 427 | 43 | 278,988 | 660 | 182 | 2.32 |
| St. Clair | 73,062 | | | 162,556 | 692,336 | 927,954 | 14,387 | 6,631 | 27,268 | 976,240 | 1,402 | 222 | 3.14 |
| Shelby | 10,718 | | | 253,263 | 60,079 | 324,060 | 67,518 | 1,160 | 365 | 392,629 | 872 | 192 | 2.35 |
| Tuscaloosa | | | | 8,691 | 24,882 | 33,573 | 52,921 | | | 86,494 | 417 | 102 | 2.04 |
| Walker | 119,208 | | 81,291 | 986,033 | 1,142,352 | 2,328,884 | 92,653 | 13,283 | 2,712 | 2,435,031 | 4,548 | 166 | 3.22 |
| Other counties (Fayette, Jackson, and Winston) | 2,138 | | | 32,463 | 64,780 | 99,381 | 7,759 | | | 107,140 | 272 | 167 | 2.36 |
| Total, Alabama | 350,924 | | 81,291 | 8,045,912 | 3,282,094 | 11,760,221 | 499,903 | 86,853 | [4] 112,007 | 12,440,322 | 22,613 | 200 | 2.74 |

ALASKA

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Alaska | | | | 93,144 | 35,464 | 128,608 | | 4 | [4] 3,251 | 131,657 | 123 | 207 | 5.16 |

ARIZONA, CALIFORNIA, GEORGIA, IDAHO, AND OREGON

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | 5,751 | 5,120 | 10,871 | 13,091 | | [4] 334 | 24,296 | 128 | 165 | 1.15 |

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## ARKANSAS

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Franklin | | | | 87,770 | 77,883 | 165,653 | 4,042 | 931 | 1,626 | 172,252 | 386 | 164 | 2.73 |
| Johnson | | | | 197,316 | 5,143 | 202,459 | 3,487 | 199 | 1,863 | 209,417 | 777 | 105 | 2.58 |
| Logan | | | | 444,963 | 191 | 445,154 | 2,989 | 165 | 702 | 451,155 | 1,233 | 146 | 2.50 |
| Pope and Scott | | | | 48,987 | | 48,987 | 2,549 | 121 | 371 | 51,817 | 183 | 136 | 2.08 |
| Sebastian | | | | 564,652 | 38,563 | 603,215 | 20,309 | 108 | 4,214 | 626,112 | 1,674 | 137 | 2.73 |
| Total Arkansas | | | | 1,343,688 | 121,780 | 1,465,468 | 33,376 | 1,524 | [4] 8,776 | 1,510,753 | 4,253 | 136 | 2.61 |

## COLORADO

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boulder | | | | 166,091 | 7,380 | 173,471 | 336,085 | 6,961 | 13,555 | 528,540 | 819 | 176 | 3.66 |
| Delta | | | | 27,762 | 10,458 | 38,220 | 25,777 | 510 | 3,604 | 68,111 | 92 | 171 | 4.33 |
| El Paso | | | | 39,072 | 2,764 | 41,836 | 243,104 | 2,638 | 5,475 | 293,053 | 335 | 216 | 4.06 |
| Fremont | | | | 199,645 | 1,071 | 200,716 | 291,048 | 3,158 | 3,369 | 503,170 | 955 | 185 | 2.85 |
| Garfield | | | | 4,681 | 18,053 | 22,734 | 29,370 | 50 | 240 | 52,394 | 50 | 254 | 4.13 |
| Gunnison | | | | 268,162 | 344,375 | 612,537 | 21,951 | 3,534 | 12,767 | 659,163 | 681 | 188 | 5.15 |
| Huerfano | | | | 322,495 | 393,399 | 715,894 | 67,111 | 4,405 | 2,240 | 787,683 | 1,258 | 178 | 3.51 |
| Jefferson | | | | 134,379 | | 134,379 | 41,874 | 1,016 | 1,797 | 179,096 | 140 | 238 | 5.37 |
| La Plata | | | | 1,220 | 10,709 | 11,929 | 27,802 | 34 | 15 | 40,180 | 65 | 206 | 3.00 |
| Las Animas | | | | 776,971 | 452,077 | 1,229,048 | 62,493 | 4,454 | [5] 128,900 | 1,425,197 | 1,943 | 185 | 3.97 |
| Mesa | | | | 8,987 | 22,586 | 31,573 | 45,886 | 809 | | 78,268 | 111 | 199 | 3.55 |
| Moffat | | | | 3,053 | | 3,053 | 15,146 | 30 | | 18,229 | 17 | 267 | 4.02 |
| Rio Blanco | | | | | | | 4,320 | | | 4,320 | 7 | 212 | 2.91 |
| Routt | | | | 879,193 | 103,485 | 982,678 | 23,102 | 5,826 | 40,629 | 1,024,621 | 1,297 | 157 | 5.04 |
| Weld | | | | 1,022,936 | 98,704 | 1,121,640 | 293,982 | 15,843 | 46,511 | 1,477,673 | 1,595 | 176 | 5.27 |
| Other counties (northern) (Elbert, Jackson, and Larimer) | | | | 12,501 | 5,118 | 17,619 | 12,290 | 465 | 1,248 | 31,622 | 45 | 206 | 3.41 |
| Other counties (southern) (Montezuma, Montrose, and Pitkin) | | | | 1,165 | | 1,165 | 14,632 | 94 | | 15,891 | 22 | 207 | 3.48 |
| Total Colorado | | | | 3,868,313 | 1,470,179 | 5,338,492 | 1,555,973 | 49,827 | [6] 260,350 | 7,187,211 | 9,432 | 181 | 4.21 |

See footnotes at end of table.

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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

ILLINOIS

| County | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | Total production, including inventory change and coal unaccounted for [3] | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel [1] | Railroad fuel all-rail [2] | Total | | | | | | | |
| Bureau | | | | 8,748 | | 8,748 | 54,159 | 2,725 | 4,496 | 70,527 | 295 | 188 | 1.27 |
| Christian | | | | 4,088,876 | 586,722 | 4,675,598 | 148,346 | 4,105 | 20,732 | 4,858,252 | 2,524 | 189 | 10.17 |
| Clinton | | | | 84,841 | 7,518 | 92,359 | 150,358 | 5,072 | 15,803 | 264,209 | 440 | 136 | 4.43 |
| Edgar | | | | 17,260 | 9,490 | 26,750 | 32,401 | 337 | 3,271 | 62,759 | 87 | 126 | 5.71 |
| Franklin | | | 53,872 | 6,396,135 | 3,188,694 | 9,638,701 | 64,242 | 35,004 | 127,978 | 9,947,541 | 6,550 | 169 | 8.97 |
| Fulton | | | | 1,911,459 | 961,823 | 2,873,282 | 409,487 | 1,689 | 16,462 | 3,308,849 | 1,683 | 181 | 10.83 |
| Gallatin | | | | | | | 29,925 | | 1,865 | 31,790 | 68 | 132 | 3.54 |
| Greene | | | | | | | 3,123 | | 12 | 3,135 | 22 | 157 | .91 |
| Grundy | | | | 3,407 | | 3,407 | 163,675 | | 1,210 | 168,292 | 247 | 123 | 5.54 |
| Henry | | | | 368,644 | 184,232 | 552,876 | 146,603 | 1,187 | 6,400 | 709,062 | 529 | 210 | 6.37 |
| Jackson | | | | 1,210,942 | 355,764 | 1,566,706 | 116,459 | 3,433 | 2,009 | 1,688,092 | 914 | 194 | 9.54 |
| Knox | | | | 386,513 | 279,664 | 666,177 | 165,895 | 2,642 | 5,547 | 842,227 | 593 | 208 | 6.82 |
| La Salle | | | | 142,883 | 11,340 | 154,223 | 292,754 | 4,143 | 12,748 | 464,596 | 876 | 157 | 3.38 |
| Livingston and Woodford | | | | 14,757 | | 14,757 | 64,015 | 2,556 | 4,795 | 86,992 | 345 | 142 | 1.78 |
| Macoupin | | | | 503,154 | 2,645,133 | 3,148,287 | 128,081 | 34,253 | 111,407 | 3,436,884 | 2,531 | 193 | 7.03 |
| Madison | | | | 697,309 | 85,889 | 783,198 | 793,753 | 7,317 | 55,665 | 1,639,109 | 1,725 | 171 | 5.56 |
| Marshall | | | | | | | 5,288 | | | 5,288 | 22 | 160 | 1.51 |
| Menard | | | | | | | 133,870 | | 4,480 | 138,350 | 174 | 207 | 3.84 |
| Mercer | | | | | | | 24,734 | | 1,363 | 26,097 | 94 | 136 | 2.04 |
| Montgomery | | | | 555,625 | 269,218 | 824,843 | 48,446 | 6,475 | 34,626 | 914,489 | 692 | 156 | 8.45 |
| Peoria | | | | 49,355 | 998,010 | 1,047,365 | 418,584 | 10,769 | 4,956 | 1,481,844 | 1,724 | 168 | 5.12 |
| Perry | | | | 2,085,404 | 1,509,736 | 3,595,140 | 80,159 | 5,920 | 45,323 | 3,762,825 | 1,890 | 175 | 11.38 |
| Randolph | | | | 600,265 | 508,813 | 1,109,078 | 97,921 | 3,737 | 19,686 | 1,230,863 | 764 | 148 | 10.91 |
| Rock Island | | | | | | | 43,838 | | 223 | 44,061 | 84 | 184 | 2.86 |
| St. Clair | | | | 794,592 | 347,015 | 1,141,607 | 1,490,967 | 13,779 | 51,654 | 2,695,310 | 2,803 | 155 | 6.20 |
| Saline | | | 2,726 | 2,416,898 | 845,431 | 3,265,053 | 62,121 | 12,464 | 56,068 | 3,387,219 | 3,785 | 136 | 6.59 |
| Sangamon | | | | 1,118,425 | 787,247 | 1,905,672 | 648,311 | 10,116 | 22,434 | 2,586,368 | 3,487 | 158 | 4.69 |
| Schuyler | | | | | | | 61,652 | | 1,052 | 62,704 | 107 | 237 | 2.47 |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shelby | | | | | | | 9,676 | | 361 | 10,037 | 77 | 122 | 1.07 |
| Stark | | | | | | | 18,403 | | 454 | 18,857 | 52 | 220 | 1.65 |
| Tazewell | | | | 23,461 | 35,640 | 59,101 | 225,202 | 568 | 963 | 285,448 | 527 | 172 | 3.15 |
| Vermilion | | | | 958,211 | 763,559 | 1,721,770 | 472,975 | 14,279 | 12,136 | 2,262,806 | 2,373 | 183 | 5.20 |
| Wabash | | | | | | | 8,683 | | 160 | 8,843 | 31 | 124 | 2.30 |
| Washington | | | | 42,771 | 207,896 | 250,667 | 64,047 | 2,965 | 16,428 | 334,406 | 394 | 147 | 5.76 |
| Williamson | | | 29,035 | 1,601,309 | 620,677 | 2,251,021 | 429,491 | 9,733 | 59,747 | 2,765,264 | 2,139 | 163 | 7.92 |
| Other counties [5] | | | | 1,098,003 | 350,285 | 1,448,288 | 503,229 | 8,049 | 35,872 | 1,998,243 | 1,801 | 159 | 6.97 |
| Total Illinois | | | 85,633 | 27,179,245 | 15,559,796 | 42,824,674 | 7,610,873 | 203,317 | [4] 758,386 | 51,601,638 | 42,449 | 168 | [7] 7.25 |

## INDIANA

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clay | | | | 716,753 | 175,327 | 892,080 | 357,356 | 845 | 3,851 | 1,256,247 | 887 | 177 | 8.00 |
| Daviess | | | | | | | 45,311 | | 690 | 46,001 | 51 | 237 | 3.80 |
| Dubois | | | | | | | 25,424 | | | 25,424 | 50 | 194 | 2.62 |
| Fountain | | | | | | | 39,637 | | | 39,637 | 53 | 148 | 5.04 |
| Gibson | | | | 936,542 | 196,387 | 1,132,929 | 131,746 | 1,586 | 23,918 | 1,289,822 | 767 | 178 | 9.43 |
| Greene | | | | 1,101,756 | 890,804 | 1,992,560 | 84,354 | 1,132 | 22,862 | 2,099,896 | 1,064 | 171 | 11.56 |
| Knox | | | | 1,090,141 | 647,732 | 1,737,873 | 164,873 | 8,787 | 17,804 | 1,933,215 | 1,101 | 204 | 8.60 |
| Martin | | | | | | | 22,167 | | | 22,167 | 45 | 200 | 2.46 |
| Owen | | | | 130,254 | 15,761 | 146,015 | 13,820 | | | 159,835 | 99 | 155 | 10.45 |
| Parke | | | | | | | 109,792 | 50 | 4,087 | 113,929 | 197 | 173 | 3.34 |
| Pike | | | | 2,058,781 | 1,083,599 | 3,142,380 | 49,192 | 862 | 17,105 | 3,208,339 | 1,051 | 199 | 15.36 |
| Spencer | | | | 11,025 | 2,458 | 13,483 | 8,439 | | | 22,046 | 55 | 84 | 4.77 |
| Sullivan | | | | 1,267,096 | 557,511 | 1,824,607 | 55,619 | 5,896 | 29,274 | 1,916,997 | 1,673 | 153 | 7.49 |
| Vanderburgh | | | | 29,635 | 72,739 | 102,374 | 47,507 | 100 | 1,100 | 151,081 | 177 | 203 | 4.20 |
| Vermillion | | | | 179,803 | 289,562 | 469,365 | 149,400 | 1,060 | 16,877 | 637,538 | 939 | 128 | 5.33 |
| Vigo | | | | 1,701,865 | 1,229,462 | 2,931,327 | 471,372 | 5,864 | 53,298 | 3,465,691 | 2,219 | 177 | 8.80 |
| Warrick | | | | 887,554 | 273,751 | 1,161,305 | 191,869 | 1,864 | 3,800 | 1,358,516 | 782 | 178 | 9.76 |
| Other counties (Perry and Warren) | | | | | | | 18,393 | | | 18,393 | 28 | 187 | 3.51 |
| Total Indiana | | | | 10,111,205 | 5,435,093 | 15,546,298 | 1,986,271 | 28,046 | [4] 194,666 | 17,764,774 | 11,238 | 174 | [7] 9.10 |

See footnotes at end of table.

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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

IOWA

| County | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | Total production, including inventory change and coal unaccounted for [3] | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel [1] | Railroad fuel all-rail [2] | Total | | | | | | | |
| Adams | | | | | | | 28,250 | | 20 | 28,270 | 180 | 151 | 1.04 |
| Appanoose | | | | 311,044 | 131,454 | 442,498 | 156,388 | 3,871 | 175 | 602,846 | 1,925 | 131 | 2.39 |
| Boone | | | | 153,830 | 82,762 | 236,592 | 97,507 | 7,918 | 1,913 | 343,930 | 987 | 142 | 2.45 |
| Dallas | | | | 215,474 | 70,754 | 286,228 | 96,098 | 7,394 | 1,720 | 393,047 | 703 | 182 | 3.08 |
| Greene | | | | | | | 40,392 | | 230 | 40,622 | 84 | 102 | 4.30 |
| Guthrie | | | | | | | 22,552 | | 18 | 22,570 | 101 | 156 | 1.43 |
| Jasper | | | | | | | 42,271 | 100 | 1,698 | 44,069 | 158 | 91 | 3.06 |
| Keokuk | | | | | | | 10,181 | | 25 | 10,206 | 26 | 94 | 4.18 |
| Lucas | | | | 3,540 | 401,434 | 404,974 | 14,602 | 7,576 | 4,766 | 431,918 | 825 | 133 | 3.94 |
| Mahaska | | | | 87,266 | 3,743 | 91,009 | 136,007 | 1,435 | 1,731 | 230,297 | 282 | 174 | 4.71 |
| Marion | | | | 60,734 | 12,009 | 72,743 | 392,961 | 2,892 | 2,113 | 470,955 | 916 | 156 | 3.29 |
| Monroe | | | | 86,350 | 21,719 | 108,069 | 72,588 | 7,172 | 1,681 | 189,352 | 387 | 156 | 3.13 |
| Page | | | | | | | 39,563 | | 25 | 39,588 | 143 | 162 | 1.71 |
| Polk | | | | 59,998 | 5,164 | 65,162 | 360,988 | 4,175 | 5,232 | 435,557 | 1,039 | 153 | 2.74 |
| Van Buren | | | | 64 | | 64 | 18,121 | | 40 | 18,225 | 52 | 169 | 2.08 |
| Wapello | | | | 12,275 | | 12,275 | 120,397 | 100 | 1,627 | 134,414 | 353 | 140 | 2.73 |
| Warren | | | | 10,595 | 594 | 11,189 | 91,473 | 1,711 | 2,668 | 107,019 | 270 | 116 | 3.41 |
| Wayne | | | | | | | 22,530 | 400 | 30 | 22,960 | 104 | 150 | 1.47 |
| Webster | | | | | | | 36,468 | | 190 | 36,658 | 91 | 164 | 2.45 |
| Other counties (Davis, Jefferson, and Taylor) | | | | 370 | | 370 | 33,668 | 493 | 20 | 34,551 | 94 | 163 | 2.25 |
| Total Iowa | | | | 1,001,540 | 729,633 | 1,731,173 | 1,833,005 | 45,237 | [4] 25,922 | 3,637,054 | 8,720 | 146 | 2.87 |

KANSAS

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bourbon | | | | 39,124 | 51 | 39,175 | 24,068 | 46 | | 63,289 | 99 | 104 | 6.12 |
| Cherokee | | | | 201,552 | 81,330 | 282,882 | 32,046 | 2,111 | 2,564 | 319,603 | 272 | 138 | 8.52 |
| Crawford | | | | 1,400,433 | 718,094 | 2,118,527 | 143,492 | 3,904 | 13,046 | 2,278,664 | 2,064 | 168 | 6.59 |
| Labette | | | | | | | 16,443 | | | 16,443 | 29 | 156 | 3.63 |
| Linn | | | | 3,550 | 2,100 | 5,650 | 27,758 | | 159 | 33,567 | 115 | 118 | 2.48 |
| Osage | | | | 628 | 1,640 | 2,268 | 87,685 | 49 | | 90,002 | 494 | 129 | 1.41 |
| Other counties (Franklin, Leavenworth, and Neosho) | | | | 71,664 | | 71,664 | 19,328 | | | 90,992 | 501 | 284 | .64 |
| Total Kansas [4] | | | | 1,716,951 | 803,215 | 2,520,166 | 350,820 | 6,110 | [4] 15,769 | 2,892,560 | 3,574 | 173 | 4.68 |

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eastern district: | | | | | | | | | | | | | |
| Bell | | 99, 203 | | 1, 404, 656 | 357, 582 | 1, 861, 441 | 80, 509 | 14, 374 | 2, 363 | 1, 961, 446 | 3, 004 | 180 | 3. 62 |
| Boyd | | | | 7, 831 | 3, 971 | 11, 802 | 30, 613 | 282 | | 42, 697 | 124 | 145 | 2. 37 |
| Breathitt | | | | 6, 083 | 41, 426 | 47, 509 | | 150 | 300 | 48, 004 | 157 | 109 | 2. 81 |
| Clay | | | | 115, 537 | 942 | 116, 479 | 9, 581 | | | 126, 060 | 264 | 178 | 2. 69 |
| Floyd | 48, 637 | 1, 426, 886 | | 2, 560, 131 | 273, 425 | 4, 309, 079 | 9, 889 | 11, 783 | 15, 247 | 4, 351, 681 | 5, 725 | 201 | 3. 78 |
| Harlan | 460 | 3, 191, 024 | | 9, 874, 696 | 783, 945 | 13, 850, 125 | 27, 516 | 78, 738 | 16, 588 | 14, 039, 371 | 13, 409 | 226 | 4. 64 |
| Jackson | | | | | | | 208, 157 | | 5, 100 | 213, 257 | 369 | 215 | 2. 69 |
| Johnson | 7, 482 | 267, 664 | | 552, 288 | 12, 902 | 840, 336 | 3, 200 | 6, 578 | 8, 153 | 858, 607 | 1, 033 | 213 | 3. 89 |
| Knott | | 118, 996 | | 271, 924 | 39, 243 | 430, 163 | | 1, 943 | | 431, 305 | 518 | 168 | 4. 95 |
| Knox | | 31, 432 | | 503, 216 | 66, 072 | 600, 720 | 4, 800 | 3, 078 | 4, 000 | 616, 889 | 747 | 239 | 3. 45 |
| Laurel | | | | 550 | | 550 | 21, 591 | | | 22, 141 | 102 | 119 | 1. 82 |
| Lee | | | | | | | 8, 165 | | | 8, 165 | 35 | 126 | 1. 85 |
| Letcher | 245, 639 | 1, 712, 482 | | 2, 240, 800 | 265, 400 | 4, 464, 321 | 1, 606 | 37, 584 | 6, 537 | 4, 516, 375 | 5, 558 | 199 | 4. 08 |
| Martin | | 400 | | 100, 295 | 175, 479 | 276, 174 | 281 | | | 276, 455 | 351 | 152 | 5. 18 |
| Perry | | 463, 343 | | 3, 252, 955 | 510, 462 | 4, 226, 760 | 74, 194 | 31, 173 | 2, 064 | 4, 338, 002 | 5, 315 | 170 | 4. 80 |
| Pike | 172, 516 | 1, 818, 448 | | 2, 440, 659 | 1, 026, 665 | 5, 458, 288 | 50, 003 | 27, 082 | 24, 564 | 5, 557, 884 | 5, 536 | 225 | 4. 46 |
| Pulaski | | | | | | | 20, 358 | | | 20, 358 | 34 | 171 | 3. 50 |
| Rockcastle | | | | | | | 18, 054 | | | 18, 054 | 54 | 109 | 3. 07 |
| Whitley | | 24, 138 | | 219, 007 | 30, 510 | 273, 655 | 28 | 4, 265 | 7, 802 | 288, 082 | 761 | 151 | 2. 51 |
| Wolfe | | | | | | | 4, 135 | | | 4, 135 | 17 | 125 | 1. 95 |
| Other counties (Carter, Greenup, McCreary, Magoffin, and Morgan) | | 15, 064 | | 589, 362 | 164, 660 | 769, 086 | 11, 175 | 4, 325 | | 784, 586 | 1, 098 | 178 | 4. 02 |
| | 474, 734 | 9, 169, 080 | | 24, 139, 990 | 3, 752, 684 | 37, 536, 488 | 583, 855 | 221, 355 | 92, 718 | 38, 523, 554 | 44, 211 | 204 | 4. 27 |
| Western district: | | | | | | | | | | | | | |
| Butler | | | | | | | 45, 794 | | | 45, 794 | 208 | 124 | 1. 78 |
| Daviess | | | | | | | 103, 021 | | 1, 725 | 104, 746 | 184 | 154 | 3. 69 |
| Henderson | | | | 7, 056 | | 7, 056 | 111, 855 | 950 | 9, 650 | 130, 417 | 269 | 151 | 3. 22 |
| Hopkins | 1, 225 | | | 1, 919, 713 | 1, 168, 955 | 3, 089, 893 | 183, 350 | 7, 582 | 19, 741 | 3, 304, 203 | 3, 970 | 152 | 5. 46 |
| Muhlenberg | | | | 1, 411, 774 | 738, 476 | 2, 150, 250 | 99, 489 | 7, 836 | 37, 586 | 2, 307, 103 | 3, 173 | 142 | 5. 11 |
| Ohio | | | 9, 755 | 308, 022 | 124, 278 | 442, 055 | 16, 818 | 3, 479 | 6, 296 | 470, 839 | 933 | 110 | 4. 58 |
| Union | | | 202, 523 | 256, 953 | 78, 039 | 537, 515 | 99, 066 | 4, 860 | 18, 192 | 661, 272 | 779 | 164 | 5. 17 |
| Webster | | | 33, 650 | 838, 351 | 500, 085 | 1, 372, 086 | 34, 784 | 5, 302 | 15, 979 | 1, 428, 151 | 1, 670 | 146 | 5. 87 |
| Other counties (Christian, and McLean) | | | | 81, 343 | | 81, 343 | 26, 427 | 395 | 2, 000 | 110, 365 | 199 | 129 | 4. 31 |
| | 1, 225 | | 245, 928 | 4, 823, 212 | 2, 609, 833 | 7, 680, 198 | 720, 604 | 30, 404 | 111, 169 | 8, 562, 890 | 11, 385 | 145 | 5. 19 |
| Total Kentucky | 475, 959 | 9, 169, 080 | 245, 928 | 28, 963, 202 | 6, 362, 517 | 45, 216, 686 | 1, 304, 459 | 251, 759 | [4] 203, 887 | 47, 086, 444 | 55, 596 | 192 | 4. 41 |

See footnotes at end of table.





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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

MARYLAND

| County | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | Total production, including inventory change and coal unaccounted for [3] | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel [1] | Railroad fuel all-rail [2] | Total | | | | | | | |
| Allegany | 35,802 | | | 712,036 | 14,215 | 762,053 | 223,782 | 4,922 | 340 | 967,264 | 1,694 | 188 | 3.03 |
| Garrett | 97,063 | | | 230,874 | 193,135 | 521,072 | 48,611 | 1,877 | 8,215 | 581,716 | 831 | 190 | 3.68 |
| Total Maryland | 132,865 | | | 942,910 | 207,350 | 1,283,125 | 272,393 | 6,799 | [4] 8,555 | 1,548,980 | 2,525 | 189 | 3.25 |

MICHIGAN

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bay | | | | 36,936 | 7,229 | 44,165 | 57,860 | 2,279 | 5,044 | 113,573 | 303 | 154 | 2.43 |
| Saginaw | | | | 8,484 | | 8,484 | 129,526 | 940 | 10,900 | 149,850 | 342 | 164 | 2.66 |
| Shiawassee | | | | | | | 103,670 | 1,450 | 2,400 | 107,520 | 222 | 151 | 3.20 |
| Other counties (Eaton, Midland, and Tuscola) | | | | 92,099 | 36,221 | 128,320 | 51,801 | 4,004 | 6,091 | 191,319 | 476 | 122 | 3.28 |
| Total Michigan | | | | 137,519 | 43,450 | 180,969 | 342,857 | 8,673 | [4] 24,435 | 562,262 | 1,343 | 145 | 2.88 |

MISSOURI

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adair | | | | 56,314 | 14,083 | 70,397 | 95,166 | 1,346 | 3,022 | 171,088 | 503 | 133 | 2.56 |
| Audrain and Howard | | | | | | | 4,210 | | | 4,210 | 35 | 102 | 1.18 |
| Barton | | | | 415,542 | 81,286 | 496,828 | 10,539 | 460 | | 509,134 | 208 | 172 | [5] 14.22 |
| Bates | | | | 553,263 | 109,823 | 663,086 | 22,183 | 149 | 4,736 | 690,154 | 327 | 169 | [5] 12.52 |
| Boone | | | | | | | 15,627 | | | 15,627 | 76 | 149 | 1.38 |
| Callaway | | | | 700 | | 700 | 84,720 | | | 85,420 | 84 | 224 | 4.54 |
| Clay | | | | 3,432 | | 3,432 | 97,594 | | 1,690 | 102,716 | 401 | 131 | 1.95 |
| Dade and Jasper | | | | | | | 13,106 | | | 13,106 | 35 | 114 | 3.29 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daviess, Grundy, and Harrison | | | | 369 | | 369 | 37,204 | | 50 | 37,623 | 131 | 175 | 1.64 |
| Henry | | | | 287,176 | 225,232 | 512,408 | 101,580 | 1,903 | 6,082 | 626,990 | 402 | 186 | [9] 8.39 |
| Johnson | | | | | | | 6,694 | | | 6,694 | 23 | 99 | 2.95 |
| Lafayette | | | | 51,303 | 154,866 | 206,169 | 103,727 | 4,773 | 3,955 | 318,624 | 1,111 | 158 | 1.82 |
| Lincoln and Warren | | | | | | | 2,672 | | 24 | 2,696 | 10 | 171 | 1.57 |
| Linn | | | | 21,995 | 3,223 | 25,218 | 75,877 | 521 | | 101,616 | 365 | 174 | 1.60 |
| Macon | | | | 262,837 | 79,257 | 342,094 | 34,008 | 1,382 | 2,479 | 382,023 | 315 | 173 | 7.01 |
| Putnam | | | | | | | 73,934 | | | 73,934 | 337 | 122 | 1.80 |
| Ralls | | | | | | | 23,795 | | | 23,795 | 57 | 199 | 2.10 |
| Randolph | | | | 320,731 | 139,862 | 460,593 | 72,899 | 1,642 | 422 | 535,662 | 452 | 201 | [9] 5.90 |
| Ray | | | | 52,315 | 61,465 | 113,780 | 134,167 | 2,434 | | 251,207 | 1,260 | 117 | 1.71 |
| Vernon | | | | 49,269 | 3,879 | 53,148 | 63,689 | | 1,929 | 118,766 | 169 | 169 | [9] 4.16 |
| Other counties (Chariton, Platte, St. Clair, and Schuyler) | | | | 2,202 | | 2,202 | 14,987 | 808 | 2,312 | 20,309 | 135 | 125 | 1.21 |
| Total Missouri [8] | | | | 2,077,448 | 872,976 | 2,950,424 | 1,088,378 | 15,418 | [4] 26,701 | 4,091,394 | 6,436 | 152 | 4.18 |
| **MONTANA** | | | | | | | | | | | | | |
| Blaine | | | | | | | 15,327 | | | 15,327 | 21 | 202 | 3.61 |
| Carbon | | | | 172,423 | 182,271 | 354,694 | 29,879 | 3,145 | 742 | 389,036 | 290 | 195 | 6.88 |
| Cascade | | | | 2,245 | 386,700 | 388,945 | 45,464 | 39 | 147 | 434,595 | 301 | 229 | 6.30 |
| Chouteau | | | | | | | 8,033 | | | 8,033 | 23 | 155 | 2.26 |
| Daniels, Roosevelt, and Valley [10] | | | | | | | [10] 12,287 | ([10]) | 50 | 12,337 | 17 | 162 | 4.47 |
| Fergus | | | | | | | 3,485 | | | 3,485 | 10 | 173 | 2.02 |
| Hill | | | | | | | 11,019 | 30 | 30 | 11,079 | 32 | 168 | 2.06 |
| Judith Basin | | | | | | | 3,269 | 20 | 23 | 3,312 | 17 | 128 | 1.52 |
| Musselshell | | | | 396,540 | 377,061 | 773,601 | 28,006 | 3,501 | 2,412 | 787,665 | 620 | 160 | 7.92 |
| Pondera | | | | | | | 4,295 | 30 | | 4,325 | 17 | 214 | 1.19 |
| Richland [10] | | | | [10] 4,000 | | 4,000 | [10] 10,667 | ([10]) | | 14,667 | 25 | 153 | 3.84 |
| Rosebud | | | | | 1,246,518 | 1,246,518 | 100 | 1,400 | 819 | 1,248,837 | 67 | 253 | [9] 73.61 |
| Sheridan [10] | | | | | | | [10] 16,977 | ([10]) | 42 | 17,019 | 26 | 179 | 3.66 |
| Other lignite counties (Custer, Dawson, and Wibaux) [10] | | | | | | | [10] 10,278 | ([10]) | 10 | 10,288 | 13 | 180 | 4.40 |
| Other bituminous counties (Phillips, Powder River, and Toole) | | | | | | | 5,158 | 30 | | 5,188 | 24 | 124 | 1.75 |
| Total Montana | | | | 575,208 | 2,192,550 | 2,767,758 | 204,244 | 8,195 | [4] 4,275 | 2,965,193 | 1,503 | 186 | 10.62 |

See footnotes at end of table.

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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

NEW MEXICO

| County | Distribution of product—net tons | | | | | | | | | Total production, including inventory change and coal unaccounted for[3] | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel[1] | Railroad fuel all-rail[2] | Total | | | | | | | |
| Colfax | | | | 178,049 | 613,961 | 792,010 | 23,711 | 5,382 | 3,059 | 837,530 | 984 | 184 | 4.62 |
| Lincoln and Socorro | | | | | | | 4,076 | | 290 | 4,366 | 26 | 159 | 1.06 |
| McKinley | | | | 309,827 | 304,946 | 614,773 | 40,708 | 5,580 | 29,813 | 691,182 | 1,137 | 210 | 2.90 |
| Rio Arriba | | | | 1,993 | 15,767 | 17,760 | 4,806 | | 90 | 22,656 | 40 | 207 | 2.73 |
| Other counties (Sandoval, San Juan, and Santa Fe) | | | | 112,219 | 15,850 | 128,069 | 13,541 | | 14,166 | 159,221 | 421 | 260 | 1.46 |
| Total New Mexico | | | | 602,088 | 950,524 | 1,552,612 | 86,842 | 10,962 | [4] 47,418 | 1,714,955 | 2,608 | 208 | 3.17 |
| NORTH DAKOTA (LIGNITE)[10] | | | | | | | | | | | | | |
| Adams | | | | 8,965 | | 8,965 | 25,171 | | 25 | 34,161 | 68 | 159 | 3.16 |
| Billings, Bowman, and Slope | | | | 193 | | 193 | 10,501 | | | 10,694 | 15 | 141 | 5.05 |
| Burke | | | | 194,643 | | 194,643 | 49,324 | | 55 | 244,022 | 84 | 215 | [9] 13.48 |
| Burleigh | | | | 219,715 | | 219,715 | 34,155 | | 30 | 253,900 | 92 | 242 | [9] 11.41 |
| Divide | | | | 191,370 | | 191,370 | 18,434 | | | 209,804 | 71 | 220 | [9] 13.46 |
| Dunn | | | | | | | 6,980 | | 400 | 7,380 | 20 | 99 | 3.73 |
| Golden Valley | | | | | | | 2,479 | | 20 | 2,499 | 7 | 129 | 2.78 |
| Grant | | | | 6,029 | | 6,029 | 22,758 | | 650 | 29,437 | 40 | 139 | 5.30 |
| Hettinger | | | | 230 | | 230 | 16,561 | | 200 | 16,991 | 35 | 165 | 2.94 |
| McKenzie | | | | | | | 4,404 | | | 4,404 | 12 | 130 | 2.81 |
| McLean | | | | 98,150 | | 98,150 | 53,520 | | 298 | 151,968 | 171 | 145 | 6.14 |
| Mercer | | | | 504,984 | | 504,984 | 80,670 | | 2,440 | 588,094 | 378 | 172 | 9.07 |
| Morton | | | | 9,611 | | 9,611 | 18,581 | | 3,025 | 31,217 | 59 | 109 | 4.88 |
| Mountrail | | | | 90 | | 90 | 12,313 | | 25 | 12,428 | 27 | 193 | 2.39 |
| Oliver | | | | | | | 8,916 | | | 8,916 | 18 | 90 | 5.50 |
| Stark | | | | 228 | | 228 | 126,652 | | 2,502 | 129,382 | 75 | 286 | 6.02 |
| Ward | | | | 342,080 | | 342,080 | 128,566 | | 75 | 470,721 | 228 | 207 | [9] 9.97 |
| Williams | | | | 928 | | 928 | 43,826 | | 65 | 44,819 | 75 | 151 | 3.96 |
| Total North Dakota | | | | 1,577,216 | | 1,577,216 | 663,811 | | [4] 9,810 | 2,250,837 | 1,475 | 181 | 8.41 |

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## OHIO

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Athens | | 245,470 | | 1,841,506 | 825,654 | 2,912,630 | 40,688 | 4,934 | 25,655 | 2,989,111 | 4,794 | 153 | 4.07 |
| Belmont | | 1,800,258 | 2,171 | 2,505,936 | 3,196,493 | 7,504,858 | 297,208 | 11,990 | 28,005 | 7,836,059 | 8,478 | 207 | 4.46 |
| Carroll | | 13,945 | | 68,239 | 27,399 | 109,583 | 161,079 | 166 | 2,040 | 273,267 | 460 | 158 | 3.77 |
| Columbiana | | | | 95,298 | 43,921 | 139,219 | 296,533 | 940 | 2,524 | 441,806 | 520 | 181 | 4.70 |
| Coshocton | | | | 46,500 | 4,608 | 51,108 | 157,184 | 662 | 1,387 | 210,836 | 326 | 171 | 3.77 |
| Gallia | | | | | | | 47,332 | | 15 | 47,547 | 68 | 268 | 2.61 |
| Guernsey | | 68,747 | | 334,204 | 337,968 | 740,919 | 130,690 | 3,499 | 1,030 | 879,877 | 1,206 | 184 | 3.97 |
| Harrison | | 283,570 | | 1,691,945 | 568,288 | 2,543,803 | 56,337 | 1,675 | 6,108 | 2,608,754 | 2,006 | 210 | 6.19 |
| Hocking | | 488 | | 95,136 | 56 | 95,680 | 114,716 | 448 | 410 | 211,254 | 320 | 156 | 4.23 |
| Holmes | | | | | | | 36,955 | 240 | 69 | 37,294 | 68 | 166 | 3.31 |
| Jackson | | | | 64,760 | 21,444 | 86,204 | 134,772 | 235 | 3,710 | 228,500 | 362 | 175 | 3.61 |
| Jefferson | | 580,018 | | 2,050,207 | 1,602,883 | 4,233,108 | 396,606 | 7,826 | 27,440 | 4,664,345 | 4,592 | 198 | 5.14 |
| Lawrence | | | | 365 | | 365 | 93,018 | 24 | | 93,407 | 201 | 194 | 2.40 |
| Mahoning | | | | 219 | | 219 | 127,282 | 249 | 7,302 | 136,377 | 222 | 181 | 3.40 |
| Medina | | | | | | | 9,977 | | 266 | 10,243 | 15 | 225 | 3.03 |
| Meigs | | 2,376 | 1,534 | 25,275 | 182 | 29,367 | 102,904 | 286 | | 132,557 | 218 | 200 | 3.04 |
| Morgan | | 15,453 | | 106,064 | 75,173 | 196,690 | 3,054 | 801 | | 200,545 | 559 | 125 | 2.87 |
| Muskingum | | | 726,754 | | | 726,754 | 164,602 | 430 | 4,561 | 899,543 | 1,101 | 179 | 4.56 |
| Noble | | 99,537 | | 84,217 | 278,436 | 462,190 | 8,157 | 1,763 | 10,845 | 486,806 | 594 | 205 | 4.01 |
| Perry | | 20,363 | | 371,378 | 244,922 | 636,663 | 220,131 | 1,992 | 237 | 860,652 | 1,542 | 142 | 3.93 |
| Portage | | | | | | | 24,006 | | 730 | 24,736 | 49 | 191 | 2.65 |
| Scioto | | | | | | | 1,421 | | | 1,421 | 14 | 67 | 1.52 |
| Stark | | | | 9,575 | | 9,575 | 569,492 | 480 | 425 | 583,685 | 695 | 181 | 4.64 |
| Summit | | | | | | | 24,451 | | 1,150 | 25,601 | 71 | 160 | 2.25 |
| Tuscarawas | | 7,500 | | 193,353 | 63,293 | 264,146 | 904,032 | 5,773 | 3,137 | 1,181,159 | 1,624 | 178 | 4.10 |
| Vinton | | | | 25,630 | 23,470 | 49,100 | 44,185 | 75 | 1,492 | 95,677 | 148 | 163 | 3.97 |
| Washington | | | | | | | 3,108 | | | 3,108 | 9 | 137 | 2.51 |
| Wayne | | | | | | | 13,688 | | 12 | 13,700 | 32 | 195 | 2.19 |
| Total Ohio | | 3,137,725 | 730,459 | 9,609,807 | 7,314,190 | 20,792,181 | 4,183,608 | 44,488 | [4] 128,550 | 25,177,867 | 30,294 | 185 | 4.49 |

## OKLAHOMA

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coal | | | | | | | 21,126 | | | 21,126 | 84 | 133 | 1.89 |
| Craig | | | | | | | 3,532 | | | 3,532 | 19 | 97 | 1.92 |
| Haskell | | | | 4,531 | 44,794 | 49,325 | 266 | | 1,051 | 50,642 | 115 | 100 | [3] 4.39 |
| Latimer | | | | 22,797 | 3,241 | 26,038 | 2,403 | 50 | 638 | 29,229 | 125 | 96 | 2.43 |
| LeFlore | | | | 367,728 | 10,011 | 377,739 | 24,797 | 2,451 | 1,070 | 406,057 | 1,093 | 141 | 2.64 |
| Muskogee | | | | 4,805 | | 4,805 | 5,830 | | | 10,635 | 46 | 82 | 2.82 |
| Okmulgee | | | | 191,393 | 123,256 | 314,649 | 28,030 | 367 | 947 | 343,597 | 616 | 146 | 3.82 |
| Pittsburg | | | | 200,877 | 7,252 | 208,129 | 18,714 | 632 | 3,448 | 231,112 | 674 | 154 | 2.23 |
| Tulsa | | | | 26,429 | 16,607 | 43,036 | 23,156 | 478 | | 66,770 | 125 | 207 | 2.58 |
| Other counties (Rogers and Wagoner) | | | | 308,755 | 79,172 | 387,927 | 41,053 | 580 | 8,035 | 437,595 | 250 | 135 | [3] 12.96 |
| Total Oklahoma | | | | 1,127,315 | 284,333 | 1,411,648 | 168,907 | 4,558 | [4] 15,189 | 1,600,295 | 3,147 | 142 | 3.58 |

See footnotes at end of table.

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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

PENNSYLVANIA (BITUMINOUS)

| County | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | Total production, including inventory change and coal unaccounted for[3] | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel[1] | Railroad fuel all-rail[2] | Total | | | | | | | |
| Allegheny | 102,273 | 3,230,633 | 1,017,063 | 5,959,271 | 1,535,033 | 11,844,273 | 3,197,386 | 64,774 | 64,036 | 15,218,351 | 15,654 | 209 | 4.65 |
| Armstrong | 3,653 | 482,204 | | 833,185 | 1,460,329 | 2,779,371 | 142,298 | 8,819 | 1,863 | 2,933,541 | 3,808 | 178 | 4.33 |
| Beaver | | | | | 702 | 702 | 133,908 | 76 | 290 | 134,976 | 317 | 192 | 2.22 |
| Bedford | 5,972 | | | 95,730 | 7,223 | 108,925 | 307,511 | 621 | [11] 65,012 | 482,237 | 994 | 169 | 2.86 |
| Blair | 78,899 | | | 26,802 | 29,917 | 135,618 | 92,752 | 1,953 | [11] 4,212 | 234,535 | 502 | 185 | 2.53 |
| Butler | | 42,573 | | 444,551 | 118,041 | 605,165 | 248,973 | 2,087 | 5,092 | 862,139 | 1,597 | 171 | 3.15 |
| Cambria | 5,408,546 | 46,562 | 77,727 | 5,895,488 | 1,280,102 | 12,708,425 | 1,857,089 | 47,650 | [11] 186,648 | 14,818,927 | 21,285 | 194 | 3.60 |
| Center | 104 | | | 360,061 | 9,300 | 369,465 | 167,440 | 210 | 193 | 537,308 | 957 | 201 | 2.79 |
| Clarion | | | | 208,494 | 922,831 | 1,131,325 | 187,918 | 946 | 145 | 1,321,891 | 1,902 | 211 | 3.30 |
| Clearfield | 370,507 | 141,176 | | 2,011,736 | 405,965 | 2,929,384 | 258,520 | 3,947 | 18,981 | 3,214,145 | 5,792 | 178 | 3.12 |
| Clinton | | | | | | | 47,414 | 511 | 842 | 48,767 | 82 | 229 | 2.59 |
| Elk | 1,010 | 8,902 | | 238,840 | 279,132 | 527,884 | 73,079 | 4,788 | 124 | 605,837 | 1,108 | 181 | 3.02 |
| Fayette | 307,309 | 1,265,461 | 12,066,898 | 2,784,324 | 977,927 | 17,401,919 | 473,241 | 60,401 | [11] 2,871,184 | 20,820,042 | 20,900 | 209 | 4.76 |
| Greene | | 894,425 | 2,699,844 | 886,813 | 76,763 | 4,557,845 | 7,646 | 20,507 | 24,830 | 4,607,642 | 4,626 | 200 | 4.98 |
| Huntingdon | 60,167 | | | 326,182 | 13,806 | 400,155 | 65,846 | 3,511 | 7,694 | 482,593 | 1,025 | 158 | 2.98 |
| Indiana | 503,697 | 792,835 | | 2,094,135 | 2,594,929 | 5,985,596 | 286,938 | 13,059 | [11] 383,537 | 6,667,054 | 8,087 | 192 | 4.29 |
| Jefferson | 192,666 | 161,850 | | 852,590 | 891,525 | 2,098,631 | 76,764 | 5,364 | 9,565 | 2,192,193 | 2,917 | 213 | 3.53 |
| Lawrence | | 27,717 | | 175,114 | | 202,831 | 58,107 | 2,075 | 3,845 | 265,288 | 485 | 221 | 2.48 |
| Lycoming | | | | 6,702 | 6,107 | 12,809 | 57,313 | 74 | 639 | 70,835 | 162 | 221 | 1.98 |
| McKean | | | | | | | 7,262 | | 15 | 7,277 | 22 | 161 | 2.06 |
| Mercer | | 21,866 | | 138,994 | | 160,860 | 146,839 | 3,239 | 5,977 | 318,813 | 627 | 180 | 2.83 |
| Somerset | 1,422,435 | | 273,853 | 2,531,900 | 750,027 | 4,978,215 | 123,971 | 32,835 | 93,437 | 5,239,328 | 7,921 | 182 | 3.63 |
| Tioga | 46,142 | | | 36,082 | 18,193 | 100,417 | 62,942 | 1,470 | 4,675 | 170,318 | 597 | 119 | 2.39 |
| Venango | | | | 161 | | 161 | 30,822 | | 5 | 30,988 | 92 | 166 | 2.03 |
| Washington | 1,238 | 3,176,307 | 5,109,458 | 6,584,133 | 3,551,384 | 18,422,520 | 481,522 | 69,896 | 39,033 | 18,895,224 | 20,204 | 216 | 4.32 |
| Westmoreland | 275,605 | 1,150,472 | | 3,948,383 | 3,787,383 | 9,161,843 | 798,472 | 59,268 | [11] 646,198 | 10,674,423 | 11,973 | 194 | 4.59 |
| Other counties (Bradford and Fulton) | 23,462 | | | 109,482 | 725 | 133,669 | 8,016 | 1,036 | 3,190 | 147,617 | 261 | 191 | 2.96 |
| Total Pennsylvania | 8,803,685 | 11,442,983 | 21,244,843 | 36,549,153 | 18,717,344 | 96,758,008 | 9,399,989 | 409,117 | [11] 4,441,262 | 111,002,289 | 133,897 | 199 | 4.16 |

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## SOUTH DAKOTA (LIGNITE) [10]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dewey and Harding | | | | 26,444 | | 26,444 | 15,274 | | | 41,718 | 29 | 194 | 7.40 |
| Meade | | | | | | | 967 | | 5 | 972 | 8 | 114 | 1.06 |
| Perkins | | | | | | | 4,289 | | | 4,289 | 10 | 122 | 3.52 |
| Total South Dakota | | | | 26,444 | | 26,444 | 20,530 | | [4] 5 | 46,979 | 47 | 165 | 6.05 |

## TENNESSEE

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anderson | | 21,806 | | 419,553 | 488,304 | 929,663 | 37,719 | 7,556 | 6,024 | 981,240 | 1,424 | 179 | 3.84 |
| Campbell | | 116,548 | | 908,121 | 341,933 | 1,366,602 | 30,236 | 8,687 | 1,335 | 1,406,661 | 2,239 | 199 | 3.15 |
| Claiborne | | 51,658 | | 386,455 | 550,159 | 988,272 | 26,903 | 5,622 | 8,250 | 1,029,507 | 1,516 | 186 | 3.66 |
| Cumberland | | | | 31,613 | | 31,613 | 8,861 | | 4,000 | 44,474 | 99 | 182 | 2.47 |
| Fentress | | | | 224.291 | 73,254 | 297,545 | 6,491 | 4,284 | 9,157 | 317,477 | 470 | 217 | 3.11 |
| Hamilton | | | | | | | 20,509 | 200 | | 20,709 | 46 | 149 | 3.01 |
| Marion | | | | 226,198 | 202,436 | 428,634 | 14,960 | 3,398 | 1,312 | 448,304 | 747 | 190 | 3.17 |
| Morgan | | | | 159,361 | 113,452 | 272,813 | 14,823 | 1,634 | [13] 12,934 | 302,204 | 844 | 255 | 1.40 |
| Overton | | | | | | | 6,088 | | 25 | 6,113 | 29 | 88 | 2.40 |
| Scott | | | | 6,933 | 82,126 | 89,059 | 6,692 | 787 | 2,396 | 100,346 | 157 | 192 | 3.32 |
| Van Buren | | | | | | | 19,617 | | 98 | 19,715 | 53 | 207 | 1.79 |
| White | | | | | | | 4,936 | | | 4,936 | 23 | 95 | 2.26 |
| Other northeastern counties (Putnam and Roane) | | | | 5,567 | 1,035 | 6,602 | 10,716 | | 55 | 17,373 | 50 | 167 | 2.08 |
| Other southeastern counties (Bledsoe, Grundy, Rhea, and Sequatchie) | | | | 173,115 | 228,646 | 401,761 | 80,503 | 3,561 | [13] 27,580 | 513,412 | 768 | 163 | 4.10 |
| Total Tennessee | | 190,012 | | 2,541,207 | 2,081,345 | 4,812,564 | 289,054 | 35,729 | [13] 73,166 | 5,212,471 | 8,465 | 195 | 3.17 |

## TEXAS

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bituminous: | | | | | | | | | | | | | |
| Palo Pinto, Webb, Wise, and Young | | | | 20,220 | 11,531 | 31,751 | 9,725 | 49 | 2,770 | 44,060 | 292 | 165 | .92 |
| Lignite:[10] | | | | | | | | | | | | | |
| Bastrop, Bexar, and Milam | | | | 153,403 | | 153,403 | 4,653 | | 448 | 158,504 | 149 | 162 | 6.58 |
| Harrison, Henderson, Titus, and Wood | | | | 676,639 | | 676,639 | 25,663 | | 5,486 | 707,788 | 378 | 240 | 7.81 |
| Total lignite | | | | 830,042 | | 830,042 | 30,316 | | 5,934 | 866,292 | 527 | 218 | 7.56 |
| Total Texas | | | | 850,262 | 11,531 | 861,793 | 40,041 | 49 | [4] 8,704 | 910,352 | 819 | 199 | 5.59 |

See footnotes at end of table.

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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

UTAH

| County | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | Total production, including inventory change and coal unaccounted for[3] | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel[1] | Railroad fuel all-rail[2] | Total | | | | | | | |
| Carbon | 12,180 | | | 2,436,924 | 608,010 | 3,057,114 | 155,242 | 17,027 | [13] 16,949 | 3,229,809 | 2,928 | 189 | 5.85 |
| Emery | | | | 252,536 | 127,457 | 380,993 | 90,548 | 1,397 | 1,354 | 474,689 | 356 | 195 | 6.83 |
| Iron and Kane | | | | | | | 3,839 | | | 3,839 | 8 | 143 | 3.36 |
| Summit | | | | 4,000 | | 4,000 | 26,018 | 168 | | 31,972 | 41 | 198 | 3.95 |
| Other counties (Grand, San Pete, Sevier, and Uintah) | | | | 19,976 | 38,320 | 58,296 | 10,763 | 267 | 50 | 69,167 | 84 | 192 | 4.30 |
| Total Utah | 12,180 | | | 2,714,436 | 773,787 | 3,500,403 | 286,410 | 18,859 | [13] 18,353 | 3,809,476 | 3,417 | 189 | 5.88 |
| VIRGINIA | | | | | | | | | | | | | |
| Buchanan | 627,470 | 737,959 | | 2,033,298 | 190,779 | 3,589,506 | 4,250 | 4,729 | 1,820 | 3,601,509 | 3,391 | 211 | 5.04 |
| Dickenson | 14,083 | 389,886 | | 1,024,243 | 295,159 | 1,723,371 | 7,363 | 9,131 | 567 | 1,742,814 | 1,549 | 258 | 4.36 |
| Lee | 105 | 46,091 | | 864,276 | 331,495 | 1,241,967 | 30,456 | 11,344 | 669 | 1,285,830 | 1,937 | 198 | 3.36 |
| Montgomery and Pulaski[14] | | | | [14] 163,604 | (14) | 163,604 | [14] 32,173 | (14) | 8,356 | 204,133 | 577 | 183 | 1.93 |
| Russell and Scott | 17,191 | | | 370,097 | 189,435 | 576,723 | 63,635 | 9,587 | 1,214 | 649,486 | 1,035 | 160 | 3.92 |
| Tazewell | 840,920 | 368,380 | | 1,639,986 | 51,548 | 2,900,834 | 85,168 | 20,809 | 8,949 | 3,009,521 | 3,650 | 204 | 4.03 |
| Wise | 507,339 | 1,303 | | 1,292,809 | 1,019,559 | 2,821,010 | 23,183 | 24,380 | [15] 429,151 | 3,301,946 | 4,355 | 181 | 4.19 |
| Total Virginia | 2,007,108 | 1,543,619 | | 7,388,313 | 2,077,975 | 13,017,015 | 246,228 | 79,980 | [15] 450,726 | 13,795,239 | 16,494 | 200 | 4.18 |
| WASHINGTON | | | | | | | | | | | | | |
| King | 7,472 | | | 376,773 | 11,649 | 395,894 | 327,376 | 3,596 | 487 | 730,233 | 1,200 | 206 | 2.95 |
| Kittitas | 2,166 | | | 277,848 | 500,793 | 780,807 | 39,693 | 12,417 | 12,766 | 898,506 | 1,039 | 225 | 3.84 |
| Lewis | | | | 7,061 | 3,051 | 10,112 | 26,138 | | 575 | 36,825 | 65 | 152 | 3.72 |
| Pierce | 2,104 | | | 52,303 | 625 | 55,032 | 18,405 | 581 | 575 | 64,906 | 299 | 88 | 2.46 |
| Other counties (Thurston and Whatcom) | 4,643 | | | 196,848 | 1,688 | 203,179 | 59,239 | 1,765 | 6,796 | 270,979 | 279 | 253 | 3.83 |
| Total Washington | 16,385 | | | 910,833 | 517,806 | 1,445,024 | 470,851 | 18,359 | [4] 21,199 | 2,001,449 | 2,882 | 204 | 3.40 |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Barbour | 3,278 | 975 | | 278,285 | 1,332,752 | 1,615,290 | 9,311 | 1,203 | 950 | 1,626,030 | 1,619 | 186 | 5.39 |
| Boone | 54,044 | 954,453 | | 2,095,356 | 628,778 | 3,732,631 | 3,107 | 24,821 | 2,843 | 3,771,776 | 3,598 | 208 | 5.05 |
| Braxton | | | | 11,256 | 19,571 | 30,827 | 5,308 | 191 | | 36,326 | 55 | 160 | 4.14 |
| Brooke | | | 33,733 | 194,340 | 204,867 | 432,940 | 989,103 | 3,934 | 205 | 1,427,789 | 1,428 | 197 | 5.08 |
| Clay | 24,223 | 67,173 | | 768,576 | 53,332 | 913,304 | 3,860 | 7,524 | 21,570 | 953.332 | 951 | 246 | 4.07 |
| Fayette | 5,431,199 | 1,583,129 | 531,328 | 3,592,499 | 543,660 | 11,681,815 | 170,960 | 92,489 | [16] 429,265 | 12,431,874 | 13,092 | 224 | 4.25 |
| Gilmer | | | | 15,529 | | 15,529 | 4,078 | 306 | | 19,913 | 71 | 108 | 2.60 |
| Grant | | | | | | | 18,896 | | | 18,896 | 51 | 152 | 2.44 |
| Greenbrier | 901,075 | 116,291 | | 550,337 | 194,798 | 1,762,501 | 26,735 | 9,269 | 169 | 1,794,947 | 1,899 | 196 | 4.83 |
| Hancock | | | | | | | 86,036 | | 945 | 86,981 | 161 | 225 | 2.40 |
| Harrison | 83,222 | 528,299 | | 1,185,184 | 2,099,229 | 3,895,934 | 90,844 | 6,867 | 3,779 | 4,000,926 | 3,441 | 175 | 6.65 |
| Kanawha | 114,059 | 1,290,809 | 1,726,753 | 3,126,141 | 584,968 | 6,842,730 | 61,116 | 49,735 | 5,547 | 7,033,250 | 7,465 | 213 | 4.43 |
| Lewis | | | | | | | 14,986 | | | 14,986 | 25 | 202 | 2.97 |
| Logan | 1,280,895 | 3,691,344 | 1,592,480 | 6,328,250 | 2,497,854 | 15,390,823 | 16,623 | 106,540 | 6,128 | 15,509,835 | 12,713 | 200 | 6.11 |
| McDowell | 4,592,689 | 4,510,810 | | 12,452,627 | 267,359 | 21,823,485 | 38,647 | 142,584 | [16] 200,056 | 22,345,986 | 20,949 | 213 | 5.01 |
| Marion | 482,807 | 1,008,026 | | 5,568,264 | 1,369,734 | 8,428,831 | 235,127 | 17,608 | 40,467 | 8,706,653 | 7,154 | 202 | 6.03 |
| Marshall | | 20,212 | 237,156 | 61,174 | 217,193 | 535,735 | 94,045 | | 144 | 629,920 | 757 | 164 | 5.07 |
| Mason | | | 1,260 | 3,317 | | 4,577 | 70,325 | 752 | 3,500 | 82,083 | 177 | 145 | 3.20 |
| Mercer | 1,069,536 | 766,718 | | 1,623,514 | 64,709 | 3,524,477 | 5,167 | 28,761 | 1,161 | 3,560,502 | 4,062 | 210 | 4.17 |
| Mineral | | | | 182,446 | 42,794 | 225,240 | 46,345 | 2,296 | 1,666 | 276,833 | 530 | 201 | 2.60 |
| Mingo | 71,778 | 713,342 | | 1,824,432 | 1,313,070 | 3,922,622 | 12,037 | 24,476 | 258 | 3,965,374 | 3,694 | 206 | 5.20 |
| Monongalia | 17,251 | 542,455 | 427,242 | 3,082,596 | 2,230,296 | 6,299,840 | 47,863 | 10,464 | 233 | 6,370,374 | 4,472 | 207 | 6.87 |
| Nicholas | 542 | | | 9,533 | 49 | 10,124 | 24,610 | | 3,023 | 37,737 | 86 | 165 | 2.67 |
| Ohio | | 395,656 | 479,311 | 461,249 | 488,362 | 1,824,578 | 231,516 | 54 | 305 | 2,058,418 | 2,060 | 241 | 4.14 |
| Preston | 46,058 | | | 353,530 | 92,219 | 491,807 | 30,820 | 1,441 | [16] 77,741 | 602,036 | 1,039 | 150 | 3.87 |
| Putnam | | | 392,659 | 21,415 | 63,988 | 478,062 | 38,156 | 2,439 | 15,776 | 504,826 | 687 | 204 | 3.60 |
| Raleigh | 4,384,574 | 1,987,810 | | 8,233,168 | 152,004 | 14,757,556 | 39,317 | 130,818 | 67,777 | 14,997,631 | 14,691 | 221 | 4.63 |
| Randolph | 229,242 | 119,625 | | 473,431 | 47,012 | 869,310 | 47,564 | 3,197 | 20,389 | 941,850 | 1,116 | 180 | 4.69 |
| Taylor | 17,815 | | | 110,026 | 489,469 | 617,310 | 23,463 | 886 | | 641,659 | 869 | 158 | 4.66 |
| Tucker | 194,275 | | | 234,263 | 51,049 | 479,587 | 6,121 | 2,845 | 18,519 | 512,494 | 646 | 182 | 4.36 |
| Upshur | 6,996 | | | 34,082 | 126,272 | 167,350 | 12,236 | 423 | 3,845 | 183,854 | 289 | 119 | 5.36 |
| Wayne | | 4,491 | | 5,750 | 4,768 | 15,009 | 11,872 | | | 26,881 | 122 | 78 | 2.83 |
| Webster | 149,406 | | | 615,187 | 62,859 | 827,452 | 5,300 | 2,231 | 1,089 | 836,072 | 1,100 | 177 | 4.30 |
| Wyoming | 764,627 | 326,861 | | 1,510,368 | 8,372 | 2,610,228 | 9,754 | 12,599 | 21,549 | 2,638,299 | 2,574 | 243 | 4.21 |
| Total West Virginia | 19,919,591 | 18,628,479 | 5,421,922 | 55,006,125 | 15,251,387 | 114,227,504 | 2,531,248 | 686,753 | [16] 948,899 | 118,646,343 | 113,643 | 209 | 5.00 |

See footnotes at end of table.





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TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

WYOMING

| County | Distribution of product—net tons | | | | | | | | | | Average number of employees | Average number of days mines operated | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loaded at mines for shipment by rail and water | | | | | | Truck deliveries including local sales | Used by mine employees | Mine fuel or made into beehive coke at mines | Total production, including inventory change and coal unaccounted for[3] | | | |
| | To tidewater | To Great Lakes | River and ex-river | All-rail other than railroad fuel[1] | Railroad fuel all-rail[2] | Total | | | | | | | |
| Campbell | | | | 61,836 | 27,763 | 89,599 | 17,387 | 639 | 6,722 | 114,347 | 42 | 247 | 11.00 |
| Carbon | | | | 87,505 | 502,454 | 589,959 | 33,344 | 3,766 | 19,785 | 646,854 | 367 | 235 | 7.50 |
| Converse | | | | | | | 10,883 | | | 10,883 | 13 | 280 | 2.99 |
| Fremont | | | | 22,757 | 6,119 | 28,876 | 11,421 | 206 | 4,970 | 45,473 | 49 | 119 | 7.82 |
| Hot Springs | | | | 171,841 | 16,948 | 188,789 | 15,395 | 2,073 | 24,091 | 230,786 | 380 | 186 | 3.27 |
| Johnson | | | | | 2,076 | 2,076 | 7,301 | 138 | 450 | 10,170 | 11 | 232 | 3.98 |
| Lincoln | | | | 178,608 | 317,583 | 496,191 | 44,463 | 4,196 | 11,179 | 558,362 | 601 | 209 | 4.44 |
| Sheridan | | | | 256,203 | 321,485 | 577,688 | 65,352 | 3,519 | 2,365 | 649,643 | 356 | 146 | 12.49 |
| Sweetwater | | | | 543,489 | 3,005,381 | 3,548,870 | 6,071 | 21,587 | 55,992 | 3,632,566 | 2,893 | 209 | 6.00 |
| Other counties (Big Horn, Natrona, and Uinta)[4] | | | | 3,491 | 4,691 | 8,182 | 10,927 | 166 | | 19,275 | 31 | 217 | 2.86 |
| Total Wyoming | | | | 1,325,730 | 4,204,500 | 5,530,230 | 222,544 | 36,290 | [4] 125,554 | 5,918,359 | 4,743 | 204 | [7] 6.11 |

[1] Includes coal reported as "shipped to distributors, destinations unknown," a small part of which may have been forwarded to tidewater or Great Lakes.
[2] Includes coal taken by locomotives at tipple.
[3] The total production differs from the sum of the items shown by the amount of the changes in inventory and of tonnage not accounted for in the distribution analysis.
[4] No coal was made into beehive coke at mines in 1937.
[5] Includes 115,278 tons made into beehive coke at mines in Las Animas County in 1937 (93,941 tons in 1936).
[6] "Other counties" include, Adams, Bond, Brown, Crawford, Hancock, Logan, Macon, Marion, Putnam, Scott, Warren, White, and Will.
[7] Much of the output of the State is obtained from strip pits or by the use of loading machines, in which types of operations the production per man per day is large.
[8] Production of Home Riverside and Alston mines is credited to Missouri rather than to Kansas.
[9] The output is chiefly obtained from strip pits, in which the production per man per day is large.
[10] Data on lignite compiled by L. Mann, Bureau of Mines; see Lignite Tables, 1937. "Loaded at mines for shipment," as published by Bureau of Mines, included under "all-rail"; "commercial sales by truck or wagon" and "other sales to local trade, etc.," as published by Bureau of Mines, included under "truck deliveries including local sales."
[11] Includes coal made into beehive coke at mines in the following counties in 1937: Bedford, 63,805; Blair, 2,732; Cambria, 67,083; Fayette, 2,753,684; Indiana, 302,980; Westmoreland, 596,818. The State total is 3,787,102 tons in 1937 against 1,907,101 tons in 1936. Does not include coal shipped in by rail or truck from mines to beehive ovens for coking, such tonnage being included under rail or truck deliveries.
[12] Includes 25,645 tons made into beehive coke at mines in Grundy County and 915 tons in Morgan County in 1937, compared with 6,886 tons in Grundy County in 1936.
[13] Includes 12,271 tons made into beehive coke at mines in Carbon County in 1937 (9,754 tons in 1936).
[14] Figures compiled by L. Mann, Bureau of Mines; see Anthracite and Semianthracite Outside of Pennsylvania Tables, 1937. "Loaded at mines for shipment," as published by Bureau of Mines, included under "all-rail"; "commercial sales by truck or wagon" and "other sales to local trade, etc.," as published by Bureau of Mines, included under "truck deliveries including local sales."
[15] Includes 412,192 tons made into beehive coke at mines in Wise County in 1937 (330,130 tons in 1936).
[16] Includes 530,651 tons made into beehive coke at mines in Fayette and Preston Counties, and briquets in McDowell County; figures for individual counties cannot be disclosed.

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PRODUCTION AND CONSUMPTION IN ALASKA

TABLE 40.—*Coal produced and consumed in Alaska, 1933–37*

| Year | Produced in Alaska, chiefly subbituminous coal and lignite [1] | | Imported from States, chiefly bituminous coal from Washington [2] (net tons) | Imported from foreign countries, chiefly bituminous coal from British Columbia [2] (net tons) | Total coal consumed (net tons) |
|---|---|---|---|---|---|
| | Net tons | Value | | | |
| 1933 | 96,467 | $481,000 | 21,524 | 14,009 | 132,000 |
| 1934 | 107,508 | 451,000 | 28,317 | 14,675 | 150,500 |
| 1935 | 119,425 | 502,000 | 26,554 | 15,707 | 161,686 |
| 1936 | 136,593 | 574,000 | 27,643 | 11,806 | 176,042 |
| 1937 | 131,657 | 553,000 | [3] 24,562 | [3] 10,781 | [3] 167,000 |

[1] Alaskan Branch of the Geological Survey.
[2] Compiled from records of the Bureau of Foreign and Domestic Commerce.
[3] Revised figures.

## STATISTICS OF LIGNITE AND HARD COAL OUTSIDE OF PENNSYLVANIA

In statistics of the Bureau of Mines the anthracite industry of Pennsylvania and the bituminous-coal industry are shown separately. Following general trade usage, the statistics of the bituminous-coal industry, as given in this and previous reports, include lignite and the small quantities of anthracite and semianthracite produced outside of Pennsylvania. Due, however, to the geographical location of the three principal lignite fields and to the inherent characteristics of hard coal, these coals have been deemed important enough to be treated in separate tables in previous issues of the Minerals Yearbook. To maintain the continuity of this supplementary series, the classification of producers heretofore used has been retained in tables 41 and 42 without reference to final determination of their status under section 17 (b) of the Bituminous Coal Act of 1937.

Preliminary estimates for 1938 indicate an output of 3,008,000 tons of lignite compared with 3,218,419 tons in 1937 and 3,109,689 in 1936. Summary statistics, by States, for 1937 are given in table 41.[6]

The production of hard coal outside of Pennsylvania during 1938 is estimated at 369,000 tons. Comparative tonnages for 1937 and 1936 were 468,852 and 520,452, respectively. Detailed data by States are presented in table 42.

[6] Tables 41 and 42 were compiled by L. Mann, Coal Economics Division, Bureau of Mines. Detailed statistics for these items were published in mimeographed form by the Bureau of Mines as follows: Lignite, January 17, 1939; anthracite and semianthracite outside of Pennsylvania, November 5, 1938. Copies of these tables are available for free distribution upon request.

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TABLE 41.—*Production, value, men employed, days mines operated, and output per man per day at lignite mines in 1937*

[Includes all coal produced in the areas mapped as "lignite" in Geological Survey Professional Paper 100-A, The Coal Fields of the United States. Note that subbituminous coal, sometimes known as "black lignite," is not included]

| | North Dakota | South Dakota | Montana [1] | Texas | Total |
|---|---|---|---|---|---|
| Production (net tons): | | | | | |
| Loaded at mines for shipment | 1,577,216 | 26,444 | 4,000 | 830,042 | 2,437,702 |
| Commercial sales by truck or wagon | 470,778 | 20,426 | 49,299 | 28,763 | 569,266 |
| Other sales to local trade or used by employees, or taken by locomotives at tipple | 193,033 | 104 | 910 | 1,553 | 195,600 |
| Used at mines for power and heat | 9,810 | 5 | 102 | 5,934 | 15,851 |
| Total production | 2,250,837 | 46,979 | 54,311 | 866,292 | 3,218,419 |
| Value: | | | | | |
| Total | $2,639,000 | $63,000 | $92,000 | $683,000 | $3,477,000 |
| Average per ton | $1.17 | $1.34 | $1.69 | $0.79 | $1.08 |
| Number of employees: | | | | | |
| Underground | 689 | 18 | 63 | 469 | 1,239 |
| Surface (including strip pits) | 786 | 29 | 18 | 58 | 891 |
| Total employees | 1,475 | 47 | 81 | 527 | 2,130 |
| Average number of days mines operated | 181 | 165 | 167 | 218 | 189 |
| Average tons per man per day | 8.41 | 6.05 | 4.00 | 7.56 | 7.98 |
| Produced by stripping (net tons) | 1,347,355 | 42,094 | [2] 88,574 | ([2]) | 1,478,023 |

[1] Custer, Daniels, Dawson, Richland, Roosevelt, Sheridan, Valley, and Wibaux Counties.
[2] Montana includes Texas.

TABLE 42.—*Production, value, men employed, days mines operated, and output per man per day at the principal hard-coal mines outside of Pennsylvania in 1937*

[Includes coal classified as anthracite and semianthracite in Geological Survey Professional Paper 100-A, The Coal Fields of the United States]

| | Arkansas | Colorado and New Mexico | Virginia | Total |
|---|---|---|---|---|
| Production (net tons): | | | | |
| Loaded at mines for shipment | 211,193 | 44,082 | 163,604 | 418,879 |
| Commercial sales by truck or wagon | 5,005 | 333 | 28,320 | 33,658 |
| Other sales to local trade, or used by employees, or taken by locomotives at tipple | 391 | 84 | 3,853 | 4,328 |
| Used at mines for power and heat | 2,564 | 1,067 | 8,356 | 11,987 |
| Total production | 219,153 | 45,566 | 204,133 | 468,852 |
| Value: | | | | |
| Total | $693,000 | $190,000 | $539,000 | $1,422,000 |
| Average per ton | $3.16 | $4.17 | $2.64 | $3.03 |
| Number of employees: | | | | |
| Underground | 756 | 120 | 436 | 1,312 |
| Surface | 165 | 45 | 141 | 351 |
| Total employees | 921 | 165 | 577 | 1,663 |
| Average number of days mines operated | 96 | 287 | 183 | 145 |
| Average tons per man per day | 2.49 | 0.96 | 1.93 | 1.94 |

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# PENNSYLVANIA ANTHRACITE

By M. VAN SICLEN, L. MANN, and J. R. BRADLEY

## SUMMARY OUTLINE


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Pressure from competitive fuels and a year of abnormally high temperatures combined to lessen the demand for anthracite, and total production fell from 51,856,000 net tons in 1937 to 46,099,000 in 1938, or 11 percent, thus receding to a point below the depression years of 1932 and 1933. This compares with a drop of 23 percent in the production of bituminous coal. The corresponding figures for commercial shipments were 46,203,000 tons in 1937 and 41,064,000 in 1938. The figures are exclusive of the output of unauthorized mines, which was closely estimated by the Pennsylvania Department of Mines at 2,500,000 net tons in 1938. This activity is concentrated largely in the Southern and Western fields. The industrial recession in 1938 had little effect on consumption of anthracite, which is primarily a fuel for domestic heating.

Prices at the mine for both domestic and steam sizes were slightly higher in 1938 than in 1937, and wholesale prices for coal on tracks at destination were about the same. Shippers to the larger markets, especially New York, were afflicted by price cutting among the producing interests on so-called distress coal, despite attempts at stabilization. As indicated by operating reports, the average of mine costs was affected adversely by the smaller production and by sporadic suspensions of work unauthorized by the labor union. Taxes remained high, and freight rates increased slightly during the year.

Withdrawal of the Canadian import duty was not achieved when the trade agreement with Canada was made, but the Canadian excise tax was removed on April 26, 1939.

New and revised State laws covering occupational diseases and workmen's compensation went into effect on January 1, 1938, which, if accepted, would greatly increase mining-company costs. However, many of the companies rejected the revised compensation act as permitted under the law.



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More encouraging were the widening effect of educational and testing work done by Anthracite Industries, Inc., and the representation of the industry by the Anthracite Institute at all public and trade matters of interest, as well as their prompt publication of trade statistics.

Provisions against the sale of illegally mined anthracite were enforced by adjoining States to the extent of funds available, and this trade became restricted more and more to Pennsylvania.

The faith of local chambers of commerce and of the people of the region generally in the future of their principal industry was shown by the raising of funds for a generous anthracite display at the New York World's Fair of 1939. The fundamental factors underlying the industry—the character of anthracite and its geographic location near thickly populated industrial centers requiring both heat and power—remain permanent and favorable.

No general legislation dealing with stabilization of the anthracite industry was passed during the year by either the State or the Federal Government.

Statistical trends in the industry for 1938 are shown in the following tables:

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TABLE 1.—*Statistical trends of the Pennsylvania anthracite industry, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Production: | | | | | |
| Loaded at mines for shipment: | | | | | |
| Breakers.....net tons | 49,435,764 | 44,369,285 | 46,256,132 | 44,016,915 | 39,010,935 |
| Washeries.....do | 966,804 | 1,794,402 | 2,066,973 | 1,837,879 | 1,379,509 |
| Dredges.....do | 353,754 | 374,142 | 324,895 | 348,350 | 373,425 |
| Sold to local trade and used by employees.....net tons | 3,285,936 | 2,874,970 | 3,226,887 | 2,981,391 | 2,722,206 |
| Used at collieries for power and heat net tons | 3,126,033 | 2,745,984 | 2,704,648 | 2,671,898 | 2,312,952 |
| Total production.....do | 57,168,291 | 52,158,783 | 54,579,535 | 51,856,433 | 46,099,027 |
| Value at breaker, washery, or dredge | $244,152,000 | $210,131,000 | $227,004,000 | $197,599,000 | $180,600,167 |
| Average sales realization per net ton on breaker shipments: | | | | | |
| Lump and broken | $5.43 | $5.16 | $5.05 | $5.08 | $5.24 |
| Egg | $5.88 | $5.44 | $5.60 | $5.06 | $5.18 |
| Stove | $6.23 | $5.87 | $6.09 | $5.21 | $5.33 |
| Chestnut | $5.98 | $5.64 | $5.91 | $5.23 | $5.36 |
| Pea | $4.40 | $4.16 | $4.30 | $4.01 | $3.88 |
| Total domestic | $5.80 | $5.45 | $5.67 | $5.01 | $5.10 |
| Buckwheat No. 1 | $2.86 | $2.88 | $2.91 | $2.95 | $3.03 |
| Buckwheat No. 2 (Rice) | $1.56 | $1.74 | $2.01 | $2.26 | $2.35 |
| Buckwheat No. 3 (Barley) | $.97 | $1.08 | $1.23 | $1.45 | $1.61 |
| Boiler | $1.25 | | | $.78 | |
| Other, including Buckwheat No. 4 | $.71 | $.57 | $.68 | $.79 | $.87 |
| Total steam | $1.98 | $2.03 | $2.10 | $2.21 | $2.33 |
| Total, all sizes | $4.53 | $4.29 | $4.42 | $4.03 | $4.16 |
| Percentage by sizes in total breaker shipments: | | | | | |
| Lump and broken.....percent | 0.3 | 0.3 | 0.3 | 0.4 | 0.3 |
| Egg.....do | 7.9 | 7.0 | 6.5 | 5.7 | 5.4 |
| Stove.....do | 22.4 | 21.8 | 21.3 | 22.1 | 23.7 |
| Chestnut.....do | 25.5 | 26.1 | 26.4 | 26.2 | 26.0 |
| Pea.....do | 10.6 | 10.7 | 10.4 | 10.8 | 10.6 |
| Total domestic.....do | 66.7 | 65.9 | 64.9 | 65.2 | 66.0 |
| Buckwheat No. 1.....do | 15.3 | 15.1 | 15.1 | 14.7 | 14.8 |
| Buckwheat No. 2 (Rice).....do | 8.6 | 9.3 | 8.4 | 7.9 | 7.7 |
| Buckwheat No. 3 (Barley).....do | 7.6 | 7.8 | 8.8 | 8.9 | 8.6 |
| Boiler.....do | [1] | | | [1] | |
| Other, including Buckwheat No. 4 percent | 1.8 | 1.9 | 2.8 | 3.3 | 2.9 |
| Total steam.....do | 33.3 | 34.1 | 35.1 | 34.8 | 34.0 |
| Producers' stocks on Dec. 31 [2].....net tons | 1,921,000 | 1,911,000 | 2,259,000 | 2,154,000 | 1,458,000 |
| Exports.....do | 1,298,000 | 1,609,000 | 1,678,000 | 1,914,000 | 1,909,000 |
| Imports.....do | 478,000 | 571,000 | 615,000 | 396,000 | 363,000 |
| Consumption (calculated).....do | 55,500,000 | 51,100,000 | 53,200,000 | 50,400,000 | 45,200,000 |
| Capacity in operation (calculated).....do | 84,000,000 | 84,000,000 | 87,000,000 | 83,000,000 | [3] |
| Average number of days worked | 207 | 189 | 192 | 189 | [3] |
| Man-days lost on account of strikes and lock-outs | 774,856 | 763,307 | 407,372 | 580,462 | [3] |
| Number of men on strike during year | 38,994 | 26,127 | 27,574 | 34,346 | [3] |
| Average number of men employed | 109,050 | 103,269 | 102,081 | 99,085 | [4] 97,000 |
| Output per man per day.....net tons | 2.53 | 2.68 | 2.79 | 2.77 | [3] |
| Output per man per year.....do | 524 | 505 | 535 | 523 | [3] |
| Quantity cut by machines.....do | 1,981,088 | 1,848,095 | 2,162,744 | 1,984,512 | 1,588,407 |
| Quantity mined by stripping.....do | 5,798,138 | 5,187,072 | 6,203,267 | 5,696,018 | 5,095,341 |
| Quantity loaded by machines underground net tons | 9,284,486 | 9,279,057 | 10,827,946 | 10,683,837 | 10,151,669 |
| Distribution: | | | | | |
| Total receipts in New England [5] net tons | 5,972,000 | 5,402,000 | 5,287,000 | 4,761,000 | 4,468,000 |
| Exports to Canada.....do | 1,266,000 | 1,592,000 | 1,664,000 | 1,893,000 | 1,896,000 |
| Loaded into vessels at Lake Erie [6] net tons | 607,000 | 559,000 | 689,000 | 674,000 | 450,000 |
| Receipts at Duluth-Superior [7].....do | 229,000 | 182,000 | 309,000 | 296,000 | 155,000 |

[1] Less than 0.1 percent.
[2] Anthracite Institute. Figures represent prepared coal on the ground at the breaker.
[3] Data not yet available.
[4] Estimated from the report of the Pennsylvania Department of Mines; Bureau of Mines data not yet available.
[5] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[6] Ore and Coal Exchange.
[7] U. S. Engineer Office, Duluth, Minn.

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TABLE 2.—*Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1938*

[All tonnage figures represent net tons]

| | 1938 | | | | | | | | | | | | | Change from preceding year, percent | 1937 (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | January | February | March | April | May | June | July | August | September | October | November | December | Total | | |
| Production, including mine fuel, local sales, and dredge coal: | | | | | | | | | | | | | | | |
| Monthly total | 4,978,000 | 3,646,000 | 4,257,000 | 3,149,000 | 4,400,000 | 4,450,000 | 2,580,000 | 2,735,000 | 3,388,000 | 4,180,000 | 3,803,000 | 4,533,000 | 46,099,000 | −11.1 | 51,856,000 |
| Average per working day | 199,100 | 155,100 | 157,700 | 126,000 | 176,000 | 171,200 | 103,200 | 101,300 | 135,500 | 167,200 | 158,500 | 174,300 | 151,900 | −11.1 | 170,900 |
| Shipments, breakers, and washeries only:[1] Monthly total, all sizes | 4,421,519 | 3,056,728 | 3,467,048 | 2,892,822 | 3,821,416 | 3,868,567 | 2,360,764 | 2,336,498 | 2,887,972 | 3,518,678 | 3,167,348 | 3,848,666 | 39,648,026 | −11.9 | 45,024,369 |
| Distribution: | | | | | | | | | | | | | | | |
| Lake Erie loadings[2] | | | | 35,858 | 55,615 | 88,490 | 86,913 | 53,370 | 35,759 | 70,531 | 23,677 | 111 | 450,324 | −33.2 | 673,768 |
| Receipts at Duluth-Superior[3] | | | | | 13,888 | 51,861 | 33,620 | 17,340 | 9,242 | 19,337 | 10,174 | | 155,462 | −47.5 | 296,003 |
| Upper Lake dock trade:[4] | | | | | | | | | | | | | | | |
| Receipts: | | | | | | | | | | | | | | | |
| Lake Superior | | | | | 18,064 | 60,663 | 33,632 | 17,345 | 9,244 | 28,663 | 10,177 | | 177,788 | −43.3 | 313,527 |
| Lake Michigan | 807 | 618 | 1,806 | 24,490 | 34,196 | 32,178 | 58,106 | 43,265 | 10,761 | 44,524 | 24,098 | 509 | 275,358 | −15.9 | 327,489 |
| Deliveries (reloadings): | | | | | | | | | | | | | | | |
| Lake Superior | 24,053 | 14,045 | 4,213 | 6,199 | 27,675 | 19,270 | 11,156 | 9,333 | 16,179 | 25,242 | 31,553 | 22,027 | 210,945 | −26.8 | 288,057 |
| Lake Michigan | 29,484 | 23,257 | 13,547 | 10,895 | 29,988 | 49,963 | 35,624 | 14,157 | 20,475 | 20,207 | 22,158 | 22,968 | 292,723 | −11.3 | 329,999 |
| Retail yards—216 selected dealers:[4] Deliveries | 461,386 | 383,870 | 352,421 | 230,279 | 222,885 | 256,626 | 260,261 | 240,910 | 304,639 | 266,659 | 275,650 | 383,249 | 3,638,835 | | (5) |
| New England receipts:[6] | | | | | | | | | | | | | | | |
| By tide (including imports) | 73,033 | 79,856 | 58,776 | 89,811 | 131,827 | 128,390 | 57,876 | 69,045 | 55,140 | 63,249 | 95,402 | 74,765 | 977,170 | −6.7 | 1,047,865 |
| By rail | 392,019 | 278,957 | 256,511 | 260,981 | 332,834 | 311,792 | 214,458 | 222,851 | 209,902 | 352,404 | 269,009 | 388,982 | 3,490,700 | −6.0 | 3,712,734 |
| Exports[7] | 189,433 | 143,139 | 135,594 | 120,278 | 248,688 | 220,390 | 125,876 | 111,748 | 144,890 | 166,723 | 142,310 | 159,842 | 1,908,911 | −.3 | 1,914,173 |
| Imports[7] | 23,698 | 41,464 | 19,584 | 32,174 | 42,306 | 36,758 | 17,938 | 20,419 | 28,444 | 20,478 | 48,430 | 31,202 | 362,895 | −8.3 | 395,737 |
| Industrial consumption by: | | | | | | | | | | | | | | | |
| Railroads (class I only)[8] | 154,411 | 136,836 | 140,306 | 110,130 | 107,632 | 90,750 | 95,325 | 94,674 | 93,690 | 115,754 | 124,230 | 142,507 | 1,406,245 | −5.5 | 1,488,802 |
| Electric-power utilities[9] | 160,260 | 127,528 | 145,230 | 144,780 | 162,803 | 163,217 | 161,452 | 174,976 | 173,183 | 184,913 | 174,413 | 198,955 | 1,971,710 | +4.1 | 1,894,650 |
| Other industrial consumers[10] | 126,498 | 120,631 | 120,234 | 96,365 | 77,706 | 67,993 | 85,191 | 92,410 | 99,450 | 91,757 | 97,855 | 86,776 | 1,162,866 | −10.0 | 1,291,835 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stocks at end of period shown: | | | | | | | | | | | | | | | |
| Railroads (class I only) [8] | 261,375 | 229,468 | 203,281 | 186,367 | 181,952 | 198,627 | 179,167 | 168,470 | 160,916 | 147,231 | 127,980 | 114,078 | 114,078 | −58.4 | 273,925 |
| Electric-power utilities [9] | 1,412,461 | 1,433,259 | 1,411,046 | 1,397,645 | 1,389,624 | 1,411,215 | 1,387,587 | 1,327,274 | 1,302,934 | 1,283,474 | 1,263,396 | 1,210,768 | 1,210,768 | −16.1 | 1,442,333 |
| Other industrial consumers [10] | 254,805 | 262,296 | 248,815 | 214,717 | 199,473 | 215,584 | 260,875 | 255,496 | 245,911 | 224,361 | 266,329 | 212,790 | 212,790 | −11.7 | 240,889 |
| Stocks on Upper Lake docks: [4] | | | | | | | | | | | | | | | |
| Lake Superior | 160,290 | 146,242 | 142,023 | 135,820 | 125,664 | 167,054 | 189,526 | 197,597 | 190,588 | 194,007 | 171,373 | 149,343 | 149,343 | −19.0 | 184,349 |
| Lake Michigan | 140,598 | 117,958 | 106,217 | 119,758 | 123,966 | 106,181 | 128,663 | 157,772 | 148,058 | 172,332 | 174,272 | 151,813 | 151,813 | −10.3 | 169,277 |
| Retail stocks from 216 selected dealers [4] | 433,578 | 334,695 | 277,275 | 340,025 | 423,779 | 486,908 | 514,661 | 525,688 | 469,703 | 542,402 | 491,206 | 462,972 | 462,972 | −6.2 | 493,471 |
| Producers' stocks [1] | 1,652,021 | 1,410,846 | 1,263,600 | 1,270,964 | 1,387,948 | 1,756,713 | 1,757,492 | 1,924,422 | 2,120,835 | 1,916,538 | 1,900,762 | 1,457,533 | 1,457,533 | −32.3 | 2,154,429 |
| Prices at mines, average per net ton: [11] | | | | | | | | | | | | | | | |
| Company stove | $6.25 | $6.25 | $6.25 | $5.75 | $5.50 | $5.56 | $5.82 | $6.10 | $6.25 | $6.25 | $6.40 | $6.40 | $6.07 | +1.5 | $5.98 |
| Company buckwheat No. 1 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | $3.50 | +4.2 | $3.36 |
| Wholesale prices: [12] | | | | | | | | | | | | | | | |
| On tracks, destination: | | | | | | | | | | | | | | | |
| Chestnut | $9.68 | $9.63 | $9.56 | $9.20 | $8.95 | $9.03 | $9.23 | $9.43 | $9.60 | $9.61 | $9.71 | $9.71 | $9.45 | +.9 | $9.37 |
| Pea | $8.35 | $8.33 | $8.27 | $7.88 | $7.63 | $7.71 | $7.90 | $8.10 | $8.17 | $8.17 | $8.27 | $8.29 | $8.09 | −.7 | $8.15 |
| Index numbers (1926=100) | 80.1 | 79.8 | 79.3 | 76.0 | 73.8 | 74.5 | 76.2 | 77.9 | 79.1 | 79.1 | 80.1 | 80.1 | 78.0 | +.3 | 77.8 |
| Labor conditions: [13] | | | | | | | | | | | | | | | |
| Average weekly earnings | $25.27 | $24.86 | $26.01 | $22.26 | $23.61 | $28.94 | $14.76 | $17.35 | $20.64 | $26.99 | $23.14 | $26.99 | $23.40 | −7.1 | $25.19 |
| Index of employment (1929 average=100) | 59.6 | 60.0 | 59.3 | 57.0 | 52.8 | 56.0 | 44.6 | 37.6 | 46.4 | 52.4 | 51.0 | 51.3 | 52.3 | −13.1 | 60.2 |
| Index of pay-roll totals (1929 average=100) | 46.5 | 46.1 | 47.3 | 39.0 | 38.3 | 49.7 | 20.2 | 20.0 | 29.4 | 43.4 | 36.2 | 42.5 | 38.2 | −18.6 | 46.9 |

[1] Anthracite Institute.
[2] Ore and Coal Exchange, Cleveland, Ohio.
[3] U. S. Engineer Office, Duluth, Minn.
[4] National Bituminous Coal Commission.
[5] Data not available.
[6] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[7] Bureau of Foreign and Domestic Commerce.
[8] Association of American Railroads.
[9] Federal Power Commission.
[10] National Association of Purchasing Agents.
[11] Computed from weekly quotations of trade journals. Figures represent circular prices on white ash coal by leading anthracite producing interests.
[12] Bureau of Labor Statistics.

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*Pennsylvania anthracite industry.*—Trade practice and historical usage recognize two major divisions in the coal industry of the United States—bituminous coal and Pennsylvania anthracite. Anthracite and semianthracite also are mined in parts of Virginia, Arkansas, Colorado, and New Mexico. Locally these coals represent distinct and important industries, but the tonnages involved are small and for statistical convenience usually are grouped with the totals of the bituminous-coal industry. Tables 41 and 42 of the chapter on Bituminous Coal in this volume record the 1937 production of anthracite and semianthracite outside of Pennsylvania; data for 1938 are not yet available.

The Pennsylvania anthracite industry, as here defined, includes all nonbituminous fields of that State. Trade usage commonly includes with Pennsylvania anthracite the output of the Bernice Basin in Sullivan County, although the coal of this basin is officially classified as semianthracite.

*Weather.*—As anthracite is essentially a household fuel the weather has an important bearing on the demand. Mild weather in the spring of 1938 and again in the late fall adversely affected the anthracite market.

The year 1938 was much warmer and slightly wetter than normal. The New England States and New York are important anthracite markets. In the New England States monthly departures from normal temperatures were January −1.3°, February +3.4°, March +1.9°, April +2.6°, October +3.0°, November +2.6°, and December +2.1°. In New York temperature deviations from normal were January −0.9°, February +5.1°, March +4.9°, April +2.4°, October −0.4°, November +2.9°, and December −0.5°. Thus, in New England during the 7 coal-burning months only 1 month was below normal and in New York only 3 months.[1]

It is thus evident that the above-normal temperatures of the leading consuming centers were responsible for a marked drop in demand for anthracite.

*Competitive fuels.*—The principal markets for Pennsylvania anthracite are the New England States, New York, New Jersey, Delaware, Maryland, Pennsylvania, and the District of Columbia, which took 84.2 percent of the production of anthracite in 1936 and 80.2 percent in 1937. Of the mineral fuels available for use in these States (excluding the important item of bituminous coal, for which no data are available, and natural and liquefied gases), the share contributed by anthracite continued to decline, as did the total apparent consumption of all fuels. Consumption of anthracite, briquets, coke, and fuel oils (in terms of coal) was equivalent to 71,706,000 tons in 1936 and declined 3.4 percent to 69,293,000 tons in 1937. Comparable data for 1938 are not yet available. Of the total fuels in 1936 and 1937, respectively, Pennsylvania anthracite comprised 64.1 and 60 percent; imported anthracite, 0.9 and 0.6 percent; briquets, 0.2 and 0.1 percent; coke for domestic use, 7.0 and 5.8 percent; imported coke, 0.3 and 0.2 percent; and heating and range oils, 27.5 and 33.3 percent. In 1937 the coal equivalent of heating and range oils available for use was more than half the tonnage of anthracite. The losses in anthracite consumption were balanced by gains in the use of heating and range oils, which increased 17 percent over 1936. Details are shown in table 3.

[1] Monthly Weather Review for January 1939, p. 16.

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TABLE 3.—*Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1936–37* [1]

[Thousands of net tons]

| Fuel | New England | New York | New Jersey | Delaware | Maryland | Pennsylvania | District of Columbia | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Quantity | Percent |
| 1936 | | | | | | | | | |
| Anthracite: | | | | | | | | | |
| All uses [2] | 4,479 | [3] 18,217 | [3] 8,482 | 250 | 713 | 13,478 | 348 | 45,967 | 64.1 |
| Imports [4] | 612 | 1 | | | | | | 613 | .9 |
| Briquets: | | | | | | | | | |
| Domestic use | 60 | 57 | 3 | 1 | 4 | 21 | 1 | 147 | .2 |
| Imports [4] | 20 | | | | | | | 20 | |
| Coke: | | | | | | | | | |
| Domestic use | 1,420 | 2,234 | 550 | 7 | 9 | 783 | 2 | 5,005 | 7.0 |
| Imports [4] | 83 | 120 | | | | | | 203 | .3 |
| Oil: Heating and range [5] | 8,003 | 6,370 | 2,731 | 87 | 477 | 1,740 | 343 | 19,751 | 27.5 |
| | 14,677 | 26,999 | 11,766 | 345 | 1,203 | 16,022 | 694 | 71,706 | 100.0 |
| 1937 | | | | | | | | | |
| Anthracite: | | | | | | | | | |
| All uses [2] | 4,129 | [3] 16,695 | [3] 7,796 | 238 | 655 | 11,777 | 296 | 41,586 | 60.0 |
| Imports [4] | 395 | | | | | | | 395 | .6 |
| Briquets: | | | | | | | | | |
| Domestic use | 40 | 36 | 2 | | 2 | 14 | 1 | 95 | .1 |
| Imports [4] | 7 | | | | | | | 7 | |
| Coke: | | | | | | | | | |
| Domestic use [6] | 1,144 | 1,800 | 443 | 6 | 7 | 631 | 2 | 4,033 | 5.8 |
| Imports [4] | 43 | 77 | | | | | | 120 | .2 |
| Oil: Heating and range [5] | 9,358 | 7,457 | 3,179 | 110 | 578 | 1,985 | 390 | 23,057 | 33.3 |
| | 15,116 | 26,065 | 11,420 | 354 | 1,242 | 14,407 | 689 | 69,293 | 100.0 |

[1] Figures for 1938 not yet available.
[2] Pennsylvania Department of Mines.
[3] An important but undetermined part of anthracite shown as shipped to New Jersey is reshipped to New York City.
[4] Bureau of Foreign and Domestic Commerce.
[5] Converted to coal equivalent on the basis of 4 barrels of fuel oil equaling 1 ton of coal.
[6] Estimated on the basis of distribution in 1936.

Sales of coke for domestic heating, fuel briquets and packaged fuel, manufactured gas for domestic use and for house heating, and natural gas for all purposes for the most part either declined or increased only moderately in 1938. Noteworthy exceptions were the increases of 19.5 percent in sales of manufactured gas for house heating in New Jersey and of 17 percent in New York. Sales of range oil and heating oils rose considerably in 1938, and sales of liquefied petroleum gases increased 42 percent over 1937. Detailed figures are shown in table 4.

The general slackening in 1938 was reflected not only in the consumption of fuels but also in the shipment of mechanical coal stokers, oil burners, and distillate oil burners. The sole exception was a 38-percent increase in factory sales of anthracite-burning types of stokers—from 9,074 units in 1937 to 12,561 in 1938.

In addition to the competition of other fuels, an invisible factor tending to decrease consumption is the more efficient combustion of anthracite, which, however, is probably less than that achieved in the technology of bituminous coal. Other factors tending to decrease consumption are the wider use of insulation in house construction, improved radiation systems, the relative increase in two-family and apartment dwellings, and the uniformly high grade of prepared sizes of anthracite which contain more heat units per ton.

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TABLE 4.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1935–38*

[Wherever available the figures represent the quantity actually consumed for domestic heating or for heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available but where the fuel is known to be used chiefly for domestic purposes, the total production (or imports) is shown to indicate the trend of growth]

| | 1924 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| SOLID FUELS (NET TONS) | | | | | |
| Pennsylvania anthracite: | | | | | |
| Production: | | | | | |
| Shipments of domestic sizes | 56, 576, 296 | 29, 653, 652 | 30, 472, 986 | 29, 092, 974 | 26, 206, 508 |
| Shipments of Buckwheat No. 1 [1] | 9, 510, 508 | 7, 211, 952 | 7, 507, 767 | 6, 859, 707 | 6, 159, 006 |
| Shipments of smaller steam sizes | 11, 160, 695 | 9, 672, 225 | 10, 667, 247 | 10, 250, 463 | 8, 698, 355 |
| Local sales | 3, 043, 939 | 2, 874, 970 | 3, 226, 887 | 2, 981, 391 | 2, 722, 206 |
| Total commercial production | 80, 291, 438 | 49, 412, 799 | 51, 874, 887 | 49, 184, 535 | 43, 786, 075 |
| Exports | 4, 017, 785 | 1, 608, 549 | 1, 678, 024 | 1, 914, 173 | 1, 908, 911 |
| Imports for consumption (chiefly from United Kingdom and U. S. S. R.) | 117, 951 | 571, 439 | 614, 639 | 395, 737 | 362, 895 |
| Fuel briquets: Calculated consumption [2] | 580, 508 | 877, 486 | 1, 113, 551 | 977, 254 | 868, 382 |
| Packaged fuel production | ---------- | 25, 244 | 66, 427 | 146, 037 | 160, 952 |
| Coke: | | | | | |
| Byproduct sales for domestic use | 2, 812, 771 | 9, 161, 980 | 9, 643, 507 | 7, 807, 792 | [3] 7, 100, 000 |
| Beehive sales for domestic use | 139, 886 | 264, 406 | 377, 836 | 299, 726 | 93, 306 |
| Imports for consumption | 82, 833 | 317, 379 | 329, 959 | 286, 364 | 135, 240 |
| Gas-house-coke sales [4] | 1, 400, 000 | 466, 000 | 403, 600 | 350, 700 | 342, 300 |
| Petroleum-coke production | 761, 100 | 1, 458, 000 | 1, 378, 200 | 1, 306, 600 | 1, 602, 200 |
| Anthracite and semianthracite production outside of Pennsylvania | 704, 513 | 423, 090 | 520, 452 | 468, 852 | [3] 369, 000 |
| Lignite production [5] | 2, 255, 385 | 2, 750, 179 | 3, 109, 689 | 3, 218, 419 | [3] 3, 008, 000 |
| Bituminous-coal sales for domestic use | ([6]) | ([6]) | ([6]) | ([6]) | ([6]) |
| OIL (BARRELS OF 42 GALLONS) | | | | | |
| Oil sales for heating buildings: | | | | | |
| Range oil [7] | ([8]) | 21, 526, 000 | 27, 292, 000 | 32, 580, 000 | [3] 36, 000, 000 |
| Heating oils: [9] | | | | | |
| Domestic | 5, 021, 000 | 76, 853, 000 | 99, 257, 000 | 116, 583, 000 | [3] 118, 000, 000 |
| Commercial | ([8]) | | | | |
| Liquefied petroleum gases, domestic | ([8]) | 509, 000 | 714, 600 | 972, 000 | 1, 377, 000 |
| GAS (MILLION CUBIC FEET) | | | | | |
| Natural gas consumption for domestic and commercial use [10] | 285, 152 | 413, 685 | 454, 969 | 489, 234 | [3] 476, 000 |
| Manufactured gas sales for: [11] | | | | | |
| Domestic use | ([8]) | 206, 636 | 198, 199 | 194, 350 | 197, 261 |
| House heating | ([8]) | 35, 040 | 41, 226 | 45, 525 | 47, 918 |

[1] A considerable part of the Buckwheat No. 1 is used for domestic purposes.
[2] Production plus imports less exports where available.
[3] Subject to revision.
[4] Partly estimated.
[5] An estimated two-thirds is used for domestic purposes.
[6] Exact data not available; estimated between 55,000,000 and 77,000,000 tons a year, including lignite and anthracite and semianthracite outside of Pennsylvania which are shown separately.
[7] Range oil is a light distillate used for house heating, hot-water heating, and cooking.
[8] Data not available.
[9] Includes all grades of fuel oil used for heating buildings.
[10] Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
[11] American Gas Association. Data revised as of March 1939.

*Consumption.*—Calculated consumption of anthracite—production, plus imports, minus exports, and plus or minus changes in producers' stocks at the beginning and end of the year—was 45,200,000 net tons in 1938, a decrease of 10 percent compared with 1937. Sales of illicit coal have not been considered in either year.

Consumption of anthracite by railroads in 1938 ranged from a high of 154,411 tons in January to a low of 90,750 tons in June, and the total for the year was 5.5 percent less than in 1937. Consumption by electric-power utilities ranged from 127,528 to 198,955 tons a month and was 4.1 percent above 1937. Other industrial consumption

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declined 10 percent. Total industrial consumption was about 135,000 tons less than in 1937.

According to a survey of the Commonwealth of Massachusetts, Division on the Necessaries of Life, the consumption of domestic sizes of anthracite in Massachusetts in the coal year 1937–38 (2,483,000 tons) was virtually the same as in 1936–37, and that of buckwheat (192,000 tons) increased 8 percent.

Imports of foreign anthracite into the New England States in 1938 (363,000 net tons) comprised 8 percent of the total receipts of anthracite into that region.

*Nonfuel uses.*—The Anthracite Institute reports that in 1938, according to replies received from companies producing 68 percent of the commercial output, more than 216,000 tons of anthracite, mostly Buckwheat No. 4 and smaller, were sold for nonfuel uses. The greatest nonfuel uses for anthracite were as follows: Reducing zinc, for which 123,000 tons were used; sintering iron ores, which required 45,000 tons; and carbonizing steel, for which 30,700 tons were used. The sale of anthrafilt continued to increase.

*Method of transport.*—There was a drastic decline in rail shipments of Pennsylvania anthracite from 1936 to 1938. Shipments by rail to the three principal markets—New York, Pennsylvania, and New Jersey—comprised 83.2 percent of total shipments in 1936, 82.6 percent in 1937, and 82 percent in 1938. However, while the percentage shipped to these markets remained almost the same the quantity dropped from 37,067,743 tons in 1936 to 32,719,986 in 1937 and 26,222,562 in 1938, an over-all decline of 29 percent. During 1938 no foreign coal was imported into these three States. Shipments to Canada fluctuated slightly but held up better during the 3-year period than did those to the domestic market.

Both the tonnage and the method of transporting anthracite to the New England States have varied considerably in the past decade. New England receipts of anthracite of domestic origin totaled 8,556,979 net tons, of which 79 percent was transported by rail, in 1929; 4,809,492 net tons, of which 74 percent was transported by rail, in 1933; and 4,105,004 net tons, of which 85 percent arrived by rail, in 1938. Receipts of anthracite at tidewater in the New England States in 1938, including imports, were 977,170 tons, a decrease of 6.7 percent compared with 1937, and receipts by rail were 3,490,700 tons, a decline of 6 percent.[2]

Loadings at Lake Erie ports dropped 33.2 percent, and receipts at Duluth-Superior were 47.5 percent less than in 1937. Shipments off Lake docks also decreased—at Lake Superior 26.8 percent and at Lake Michigan 11.3 percent.

In March 1938 the Pennsylvania Public Utilities Commission reduced the freight rates to a number of points within the State of Pennsylvania. In the same month a small increase in the rates on interstate shipments of anthracite was allowed by the Interstate Commerce Commission. This increase was extended late in 1938 by the Interstate Commerce Commission to cover intrastate shipments. The so-called motor-compelled freight rates again were extended.

[2] Commonwealth of Massachusetts, Division on the Necessaries of Life.



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Details covering distribution of shipments of Pennsylvania anthracite by rail (truck shipments excluded) for 1936–38 are shown in table 5.

TABLE 5.—*Shipments of Pennsylvania anthracite, 1936–38, by States of destination, in net tons* [1]

[Truck shipments excluded]

| | 1936 | 1937 | 1938 | | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|
| New England States | 4,478,509 | 4,128,408 | 3,551,572 | Wisconsin | 462,435 | 429,965 | 345,445 |
| New York | 17,815,434 | 16,388,675 | 13,214,996 | Minnesota | 121,612 | 120,930 | 77,461 |
| New Jersey | 8,186,524 | 7,533,475 | 6,180,129 | Michigan | 287,613 | 300,316 | 214,768 |
| Pennsylvania | 11,065,785 | 8,797,836 | 6,827,437 | Other States | 109,393 | 91,314 | 65,873 |
| Delaware | 238,121 | 213,493 | 168,316 | Total United States | 44,559,959 | 39,633,803 | 31,968,971 |
| Maryland | 673,461 | 614,218 | 545,454 | Canada | 1,546,328 | 1,773,086 | 1,631,489 |
| District of Columbia | 341,863 | 290,524 | 248,577 | Other foreign countries | 3,977 | | 4,476 |
| Virginia | 121,350 | 107,744 | 103,580 | | | | |
| Ohio | 158,577 | 168,565 | 91,017 | Grand total | 46,110,264 | 41,406,889 | 33,604,936 |
| Indiana | 93,165 | 90,286 | 80,153 | | | | |
| Illinois | 406,117 | 358,054 | 254,193 | | | | |

[1] Department of Mines, Harrisburg, Pa.

Table 6 shows the quantity of Pennsylvania anthracite shipped by originating railways in 1937 and 1938, as reported by the Anthracite Institute.

TABLE 6.—*Anthracite shipments by originating railways, 1937–38, in net tons* [1]

| | 1937 | 1938 |
|---|---|---|
| Reading R. R. Co | 9,292,812 | 7,935,661 |
| Lehigh Valley R. R | 9,232,590 | 8,203,136 |
| Central R. R. of New Jersey | 3,815,414 | 2,907,036 |
| Delaware, Lackawana & Western R. R | 6,028,524 | 5,569,657 |
| Delaware & Hudson R. R. Corporation | 4,350,232 | 3,734,537 |
| Pennsylvania R. R | 5,034,142 | 4,048,644 |
| Erie R. R | 3,629,973 | 3,455,991 |
| New York, Ontario & Western Ry | 1,568,942 | 1,741,229 |
| Lehigh & New England R. R | 2,071,740 | 2,052,135 |
| | 45,024,369 | 39,648,026 |

[1] Anthracite Institute.

Incomplete returns on shipments of anthracite in 1938 by destinations, compiled and published monthly by the Pennsylvania Department of Mines, show that about 9 percent of the total shipments move by truck; the corresponding figure in 1937 was 8 percent. Most of the anthracite trucked goes to nearby points. In 1938, about 85 percent of the truck shipments were to destinations in Pennsylvania (60 percent within the anthracite region). As might be expected, New Jersey and New York were the next largest markets, with Delaware, Maryland, and the District of Columbia following in decreasing order. Less than 1,000 tons went by truck to New England and insignificant quantities to Ohio and Canada.

*Stocks.*—At the end of 1938, stocks of anthracite in the hands of railroads, electric-power utilities, and other industrial consumers were 21.4 percent less than at the end of 1937. Railroad stocks dropped 58.4 percent, electric-power-utility stocks 16.1 percent, and stocks of other industrial consumers 11.7 percent. Stocks on upper Lake docks

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declined 14.8 percent—on Lake Superior 19 percent and on Lake Michigan 10.3 percent. Retail stocks declined 6.2 percent and producers' stocks 32.3 percent.

Recent trends in production and stocks are shown in figure 1.

*Promotional and regulatory activities.*—The Anthracite Institute carried on its usual activities during 1938. Officials of the institute followed closely proposed Pennsylvania legislation to regulate the industry; filed a brief with the Committee for Reciprocity Information requesting that the Canadian duty on United States anthracite be removed; carried on its statistical services; and continued to cooperate with the Bureau of Mines. No change had been made in the import duty by the close of the year, nor had the excise tax been removed. However, the prospect for removal of the excise tax, provided for in the Canadian Trade Agreement which was provisionally scheduled to go into effect January 1939, probably explained the decrease in exports of anthracite to Canada during the latter months of 1938. The tax was removed in April 1939.

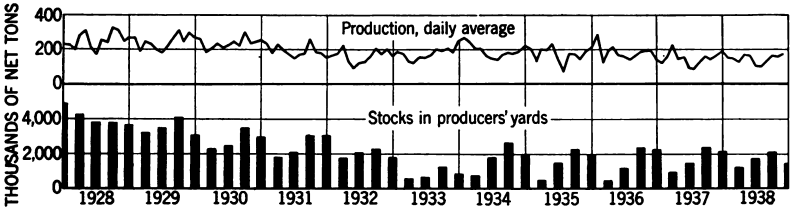


FIGURE 1.—Trends in production and stocks of Pennsylvania anthracite, 1928–38.

Anthracite Industries, Inc., established in the spring of 1936, has become an important agency in developing the market for anthracite and making available to the public higher standards of comfort and convenience in domestic heating. During 1938 Anthracite Industries increased the intensity of its activities. In addition to maintaining first-hand contact with consumers and the trades connected with the industry, its laboratory at Primos, Pa., continued to test for approval anthracite-burning equipment and accessories, and additional schools were conducted to apprise salesmen and others of new developments. Additional showrooms were opened, and the general advertising program was extended.

The first annual anthracite conference, sponsored by Lehigh University was held at Bethlehem, Pa., for 2 days late in April 1938. Papers on reserves, geology, characteristics, and uses of anthracite, description and operation of burning equipment, commercial applications, and merchandising and civic values of anthracite were read and discussed before audiences composed of men interested in all phases of the industry.

The office of the retail solid fuel coordinator of New York City continued its usual duties of policing the New York City market—the largest single anthracite market in the country—against short weight, stolen coal, infractions of coal ordinances, unlicensed truckers, increased freight rates, counterfeit certificates of origin, misrepresentation of coal, and evasion of sales tax and in other details involving the proper operation of the retail industry.

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In August 1938, following the report and recommendations of the Pennsylvania Anthracite Coal Industry Commission, bills were introduced in the Pennsylvania House providing for production control; licensing mines; fixing sales quotas and minimum and maximum prices at the mines, as well as retail prices; cooperative marketing; creating an anthracite public authority with power to mine, transport, and sell anthracite, to issue bonds, and to have the right of eminent domain; and, finally, creating the Pennsylvania Anthracite Commission as an independent administrative commission. The House adjourned without passing the bills.

Revisions of the State workmen's compensation act by the Pennsylvania Legislature in 1937 went into effect on January 1, 1938, as did a new law that made occupational diseases compensable. Some operators estimated that the cost to the industry for compensation, which in 1937 approximated $2,500,000, would, under the amended act, eventually amount to $7,500,000 a year. As a result, and as permitted by the law, a substantial majority of the producing companies rejected the act as amended but announced that they would voluntarily settle with all claimants on the basis of the law as operated in 1937.

*Technologic developments.*—No outstanding change in the methods of mining anthracite was developed during 1938, either underground or in strip pits. To meet intensive competition both within and without the industry, many minor improvements were made in demonstrated and accepted methods, as is usual under the pressure of decreasing costs, without lowering the grade.

The same can be said of the utilization of anthracite. The design of screw-type automatic stokers was further strengthened and refined, and attention was redirected to the thermal efficiency of furnaces and boilers.

In the field of beneficiation of the raw coal—now occupied by the time-tried screens, jigs, and sand cones with certain auxiliary equipment—a new method was announced by Dupont after several years of intensive laboratory and pilot-plant development which culminated in a commercial demonstration plant at the Weston breaker near Shenandoah, Pa. The process employs the familiar float-and-sink method, but its success is based principally on three factors: Development of suitable halogenated hydrocarbons as parting liquids; discovery of surface-active reagents which in solution greatly reduce loss of the parting liquid by preventing it from adhering to the pieces of anthracite; and assembly of standard equipment to form a continuous, water-sealed operation. As developed to date this process is applicable to the domestic sizes of anthracite. It does not remove the need for preliminary and final screening but is alternative to jigs or sand cones. What permanent place it will occupy in the preparation of anthracite for market cannot be foretold.

*Sources and acknowledgments.*—Annual statistics of the Pennsylvania anthracite-mining industry are prepared from a canvass by mail of all known anthracite operations, including some 400 active producers. About 95 percent of the tonnage is reported directly by producers, and the remaining 5 percent is estimated by personal inspection and collateral evidence. The data furnished by the producers on individual operations are voluntary and confidential, as is customary in the statistical services of the Bureau of Mines.

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The standard form of report, as developed by the Bureau and its predecessor in mineral statistics, the Geological Survey, provides for data on production, shipments, mine realization of products, mine stocks, plant and equipment, and employment.

In assembling available detailed information free use has been made of the pertinent figures prepared by the Anthracite Institute, the American Association of Railroads, and the Pennsylvania Department of Mines, to all of whom thanks are extended for their cordial and continued cooperation. Thanks are due especially to the producers for reporting so promptly and, in general, so fully upon their 1938 operations, when the year as a whole was so critical for the industry.

Final 1937 figures for employment and number of operations were published on September 10, 1938, as a supplement to Weekly Anthracite-Beehive Coke Report 61 and are incorporated in the present Yearbook. Corresponding 1938 figures are not yet available but will be similarly published when completed and included for permanent record in the next volume of the Yearbook. Advance summaries of final production figures for 1938 were published on June 17, 1939, as a supplement to Weekly Anthracite-Beehive Coke Report 101. They are presented in detail in this chapter.

## PRODUCTION

*By weeks and months.*—The following tables summarize the statistics of weekly and monthly production of anthracite. Statistics of current output are estimated from tonnage reports from trade sources and from records of car loadings. The weekly and monthly figures in tables 7 and 8 have been adjusted to the annual total ascertained by direct canvass of the operators.

TABLE 7.—*Estimated weekly production of Pennsylvania anthracite in 1938, in net tons*

| Week ended— | Weekly production | Number of working days | Daily average | Week ended— | Weekly production | Number of working days | Daily average |
|---|---|---|---|---|---|---|---|
| Jan. 1 | (1) | (1) | (1) | July 16 | 557,000 | 6 | 92,800 |
| 8 | 847,000 | 6 | 141,200 | 23 | 639,000 | 6 | 106,500 |
| 15 | 1,274,000 | 6 | 212,300 | 30 | 1,003,000 | 6 | 167,200 |
| 22 | 1,367,000 | 6 | 227,800 | Aug. 6 | 547,000 | 6 | 91,200 |
| 29 | 1,279,000 | 6 | 213,200 | 13 | 425,000 | 6 | 70,800 |
| Feb. 5 | 1,180,000 | 6 | 196,700 | 20 | 410,000 | 6 | 68,300 |
| 12 | 867,000 | 6 | 144,500 | 27 | 687,000 | 6 | 114,500 |
| 19 | 797,000 | 6 | 132,800 | Sept. 3 | 948,000 | 6 | 158,000 |
| 26 | 872,000 | 5.5 | 158,500 | 10 | 516,000 | 5 | 103,200 |
| Mar. 5 | 1,136,000 | 6 | 189,300 | 17 | 879,000 | 6 | 146,500 |
| 12 | 1,057,000 | 6 | 176,200 | 24 | 819,000 | 6 | 136,500 |
| 19 | 664,000 | 6 | 110,700 | Oct. 1 | 921,000 | 6 | 153,500 |
| 26 | 716,000 | 6 | 119,300 | 8 | 1,143,000 | 6 | 190,500 |
| Apr. 2 | 877,000 | 5 | 175,400 | 15 | 1,185,000 | 6 | 197,500 |
| 9 | 851,000 | 6 | 141,800 | 22 | 864,000 | 6 | 144,000 |
| 16 | 934,000 | 6 | 155,700 | 29 | 880,000 | 5 | 176,000 |
| 23 | 667,000 | 6 | 111,200 | Nov. 5 | 887,000 | 6 | 147,800 |
| 30 | 645,000 | 6 | 107,500 | 12 | 818,000 | 5 | 163,600 |
| May 7 | 859,000 | 6 | 143,200 | 19 | 858,000 | 6 | 143,000 |
| 14 | 844,000 | 6 | 140,700 | 26 | 653,000 | 5 | 130,600 |
| 21 | 1,120,000 | 6 | 186,700 | Dec. 3 | 1,214,000 | 6 | 202,300 |
| 28 | 1,332,000 | 6 | 222,000 | 10 | 984,000 | 6 | 164,000 |
| June 4 | 1,174,000 | 5 | 234,800 | 17 | 957,000 | 6 | 159,500 |
| 11 | 898,000 | 6 | 149,700 | 24 | 1,030,000 | 6 | 171,700 |
| 18 | 726,000 | 6 | 121,000 | 31 | 1,014,000 | 5 | 202,800 |
| 25 | 962,000 | 6 | 160,300 | | | | |
| July 2 | 991,000 | 6 | 165,200 | Calendar year | 46,099,000 | 303.5 | 151,900 |
| 9 | 325,000 | 5 | 65,000 | | | | |

[1] Jan. 1 considered a full holiday; there were no loadings on that day.

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TABLE 8.—*Estimated monthly production of Pennsylvania anthracite, 1935–38* [1]

[Production figures represent thousands of net tons

| Month | 1935 | | | 1936 | | | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monthly production | Number of working days | Daily average | Monthly production | Number of working days | Daily average | Monthly production | Number of working days | Daily average | Monthly production | Number of working days | Daily average |
| January | 5,790 | 26 | 223 | 5,315 | 26 | 204 | 4,236 | 25 | 169 | 4,978 | 25 | 199 |
| February | 4,652 | 23.5 | 198 | 6,952 | 24.5 | 284 | 3,671 | 23.5 | 156 | 3,646 | 23.5 | 155 |
| March | 3,228 | 26 | 124 | 3,051 | 26 | 117 | 4,795 | 27 | 178 | 4,257 | 27 | 158 |
| April | 4,763 | 25 | 191 | 4,757 | 25 | 190 | 6,779 | 25 | 271 | 3,149 | 25 | 126 |
| May | 5,118 | 26 | 197 | 5,104 | 25 | 204 | 4,361 | 25 | 174 | 4,400 | 25 | 176 |
| June | 5,724 | 25 | 229 | 4,292 | 26 | 165 | 4,635 | 26 | 178 | 4,450 | 26 | 171 |
| July | 3,502 | 26 | 135 | 3,912 | 26 | 151 | 2,748 | 26 | 106 | 2,580 | 25 | 103 |
| August | 3,073 | 27 | 114 | 3,492 | 26 | 134 | 2,903 | 26 | 112 | 2,735 | 27 | 101 |
| September | 4,113 | 24 | 171 | 3,861 | 25 | 154 | 3,682 | 25 | 147 | 3,388 | 25 | 136 |
| October | 4,132 | 26 | 159 | 4,593 | 26 | 177 | 4,848 | 25 | 194 | 4,180 | 25 | 167 |
| November | 3,432 | 24 | 143 | 4,320 | 23 | 188 | 4,439 | 24 | 185 | 3,803 | 24 | 159 |
| December | 4,632 | 25 | 185 | 4,931 | 26 | 190 | 4,759 | 26 | 183 | 4,533 | 26 | 174 |
| | 52,159 | 303.5 | 172 | 54,580 | 304.5 | 179 | 51,856 | 303.5 | 171 | 46,099 | 303.5 | 152 |

[1] Production is estimated from weekly car loadings as reported by the Association of American Railroads and includes mine fuel, coal sold locally, and dredge coal. Does not include an unknown amount of "bootleg" production. In computing the average rates per working day, New Year's, Eight-hour Day (Apr. 1), Memorial Day, Independence Day, Labor Day, Mitchell Day (Oct. 29), Thanksgiving Day, Christmas, and, since the war, Armistice Day, have been counted as holidays. Beginning with 1927, Washington's Birthday is counted as a half holiday. No allowance, however, has been made for church holy days, which are observed by many of the miners. Monthly statistics from 1905 to 1925 will be found in Coal in 1925, pp. 427–428, and from 1926 to 1930 in Coal in 1930, p. 741.

*By regions, fields, and counties.*—The main anthracite region covers an elongated area of about 480 square miles in eastern Pennsylvania, with its longer axis running northeast and southwest. It embraces three subregions as follows, from the northeast to the southwest: The Wyoming region, which covers a single geologic anthracite basin and is about 54 miles long by 6 miles wide at its widest point; the Lehigh region, which comprises the anthracite lands tributary to the Lehigh River that forms its eastern boundary and contains the Eastern Middle field and the portion of the Southern field lying east of Tamaqua; and the Schuylkill region, which consists of the Western Middle field and the portion of the Southern field lying west of Tamaqua.

The area may also be divided into 4 fields, using the grouping of the anthracite geologic basins as a framework, as follows: The Northern field, which is the same as the Wyoming region; the Eastern Middle, or Lehigh field, which consists of a group of at least 10 small basins; the Western Middle field, a single basin about 36 miles long by 4½ miles at its widest point; and the Southern field, also a single basin, about 54 miles long by 6 miles at its widest point, which breaks into a long "fishtail" toward its western ends.

Both classifications (by regions and by fields) are used in the Bureau tables, the former for regional comparative trade statistics and the latter for comparative methods and costs of mining as governed by physical conditions.

In order of magnitude of present production, the Northern field comes first, followed by the Western Middle, the Southern, and the Eastern Middle.

In order of length of life, based on estimated minable reserves, the Southern field comes first, followed by the Western Middle, the Northern, and the Eastern Middle fields.[3]

[3] Ashley, George H., Anthracite Reserves and Geology: Trans. 1st Ann. Anthracite Conference, April 1938, pp. 11–24.

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TABLE 9.—*Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1938, by regions*

| Region | Shipments | | Local sales | |
|---|---|---|---|---|
| | Net tons | Value [1] | Net tons | Value |
| Lehigh: | | | | |
| Breaker product | 7,039,520 | $29,063,863 | 272,555 | $1,266,319 |
| Dredge product | 54,262 | 62,834 | | |
| Total Lehigh | 7,093,782 | 29,126,697 | 272,555 | 1,266,319 |
| Schuylkill: | | | | |
| Breaker product | 10,714,017 | 41,352,715 | 655,189 | 2,254,043 |
| Washery product | 1,489,529 | 3,767,480 | 70,869 | 253,474 |
| Dredge product | 319,163 | 289,127 | 166,793 | 172,239 |
| Total Schuylkill | 12,522,709 | 45,409,322 | 892,851 | 2,679,756 |
| Wyoming: | | | | |
| Breaker product | 21,239,085 | 91,784,934 | 1,474,886 | 6,544,477 |
| Washery product | 189,980 | 479,620 | 24,827 | 65,625 |
| Dredge product | | | 29,491 | 45,102 |
| Total Wyoming | 21,429,065 | 92,264,554 | 1,529,204 | 6,655,204 |
| Total, excluding Sullivan County: | | | | |
| Breaker product | 38,992,622 | 162,201,512 | 2,402,630 | 10,064,839 |
| Washery product | 1,679,509 | 4,247,100 | 95,696 | 319,099 |
| Dredge product | 373,425 | 351,961 | 196,284 | 217,341 |
| Total | 41,045,556 | 166,800,573 | 2,694,610 | 10,601,279 |
| Sullivan County: [2] Breaker product | 18,313 | 38,991 | 27,596 | 80,557 |
| Grand total: 1938 | 41,063,869 | 166,839,564 | 2,722,206 | 10,681,836 |
| 1937 | 46,203,144 | 182,302,758 | 2,981,391 | 11,673,258 |
| Change, 1938 percent | −11.1 | −8.5 | −8.7 | −8.5 |

| Region | Colliery fuel | | Total | |
|---|---|---|---|---|
| | Net tons | Value | Net tons | Value [1] |
| Lehigh: | | | | |
| Breaker product | 390,063 | $700,781 | 7,702,138 | $31,030,963 |
| Dredge product | | | 54,262 | 62,834 |
| Total Lehigh | 390,063 | 700,781 | 7,756,400 | 31,093,797 |
| Schuylkill: | | | | |
| Breaker product | 471,114 | 738,109 | 11,840,320 | 44,344,867 |
| Washery product | 5,875 | 8,393 | 1,566,273 | 4,029,347 |
| Dredge product | 1,315 | 1,277 | 487,271 | 462,643 |
| Total Schuylkill | 478,304 | 747,779 | 13,893,864 | 48,836,857 |
| Wyoming: | | | | |
| Breaker product | 1,345,627 | 1,529,397 | 24,059,598 | 99,858,808 |
| Washery product | 95,684 | 98,080 | 310,491 | 643,325 |
| Dredge product | | | 29,491 | 45,102 |
| Total Wyoming | 1,441,311 | 1,627,477 | 24,399,580 | 100,547,235 |
| Total, excluding Sullivan County: | | | | |
| Breaker product | 2,206,804 | 2,968,287 | 43,602,056 | 175,234,638 |
| Washery product | 101,559 | 106,473 | 1,876,764 | 4,672,672 |
| Dredge product | 1,315 | 1,277 | 571,024 | 570,579 |
| Total | 2,309,678 | 3,076,037 | 46,049,844 | 180,477,889 |
| Sullivan County: [2] Breaker product | 3,274 | 2,730 | 49,183 | 122,278 |
| Grand total: 1938 | 2,312,952 | 3,078,767 | 46,099,027 | 180,600,167 |
| 1937 | 2,671,898 | 3,622,833 | 51,856,433 | 197,598,849 |
| Change, 1938 percent | −13.4 | −15.0 | −11.1 | −8.6 |

[1] Value given is value at which coal left possession of producing company, f. o. b. mines, and does not include margins of separately incorporated sales companies.

[2] For purposes of historical comparison and statistical convenience the mines of Sullivan County are grouped with the Pennsylvania anthracite region, although the product is classified as semianthracite according to the American Society for Testing Materials Tentative Standard.

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TABLE 10.—*Pennsylvania anthracite produced, by fields, 1934–38, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 561,960 tons in 1938. Data for 1913–25 will be found in Coal in 1925, p. 517, and for 1926–30 in Coal in 1930, p. 747]

| Field | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Eastern Middle: | | | | | |
| Breakers | 6,013,462 | 5,248,176 | 6,102,979 | 6,045,813 | 5,217,169 |
| Washeries | | | | | |
| Total Eastern Middle | 6,013,462 | 5,248,176 | 6,102,979 | 6,045,813 | 5,217,169 |
| Western Middle: | | | | | |
| Breakers | 12,417,648 | 10,231,664 | 11,469,078 | 10,381,521 | 8,877,485 |
| Washeries | 801,391 | 1,483,023 | 1,510,913 | 1,456,505 | 940,938 |
| Dredges | 213,567 | 231,711 | 221,800 | 264,588 | 223,961 |
| Total Western Middle | 13,432,606 | 11,946,398 | 13,201,791 | 12,102,614 | 10,042,384 |
| Southern: | | | | | |
| Breakers | 7,384,649 | 6,091,307 | 6,439,213 | 5,849,381 | 5,447,804 |
| Washeries | 82,910 | 99,204 | 438,465 | 218,541 | 625,335 |
| Dredges | 409,448 | 339,529 | 303,984 | 468,386 | 317,572 |
| Total Southern | 7,877,007 | 6,530,040 | 7,181,662 | 6,536,308 | 6,390,711 |
| Northern: | | | | | |
| Breakers | 29,322,571 | 27,700,235 | 27,448,035 | 26,707,743 | 24,059,598 |
| Washeries | 302,540 | 524,742 | 405,615 | 347,959 | 310,491 |
| Dredges | 29,165 | 19,227 | 20,900 | 27,500 | 29,491 |
| Total Northern | 29,654,276 | 28,244,204 | 27,874,550 | 27,083,202 | 24,399,580 |
| Total, excluding Sullivan County: | | | | | |
| Breakers | 55,138,330 | 49,271,382 | 51,459,305 | 48,984,458 | 43,602,056 |
| Washeries | 1,186,841 | 2,106,969 | 2,354,993 | 2,023,005 | 1,876,764 |
| Dredges | 652,180 | 590,467 | 546,684 | 760,474 | 571,024 |
| | 56,977,351 | 51,968,818 | 54,360,982 | 51,767,937 | 46,049,844 |
| Sullivan County: Breakers | 190,940 | 189,965 | 218,553 | 88,496 | 49,183 |
| Grand total | 57,168,291 | 52,158,783 | 54,579,535 | 51,856,433 | 46,099,027 |

TABLE 11.—*Pennsylvania anthracite produced in 1938, by counties*

| County | Shipments | | Local sales | |
|---|---|---|---|---|
| | Net tons | Value [1] | Net tons | Value |
| Carbon | 1,685,815 | $6,598,294 | 57,762 | $253,654 |
| Columbia | 783,542 | 3,160,773 | 45,222 | 120,721 |
| Dauphin | 349,397 | 1,511,157 | 111,987 | 131,978 |
| Lackawanna | 6,978,103 | 29,711,982 | 674,806 | 3,070,345 |
| Luzerne | 17,736,234 | 76,815,018 | 1,003,355 | 4,311,951 |
| Northumberland | 3,883,344 | 14,646,609 | 305,505 | 774,005 |
| Schuylkill | 9,381,919 | 33,761,938 | 462,519 | 1,863,664 |
| Sullivan | 18,313 | 38,991 | 27,596 | 80,557 |
| Susquehanna and Wayne | 158,859 | 497,726 | 11,195 | 50,253 |
| Berks, Lebanon, Northampton, and York [2] | 88,343 | 97,076 | 22,259 | 24,708 |
| | 41,063,869 | 166,839,564 | 2,722,206 | 10,681,836 |

| County | Colliery fuel | | Total | |
|---|---|---|---|---|
| | Net tons | Value | Net tons | Value [1] |
| Carbon | 67,630 | $157,580 | 1,811,207 | $7,009,528 |
| Columbia | 57,989 | 101,601 | 886,753 | 3,383,095 |
| Dauphin | 4,257 | 6,635 | 465,641 | 1,649,770 |
| Lackawanna | 466,585 | 579,724 | 8,119,494 | 33,362,051 |
| Luzerne | 1,188,762 | 1,406,818 | 19,928,351 | 82,533,787 |
| Northumberland | 64,418 | 103,461 | 4,253,267 | 15,524,075 |
| Schuylkill | 443,316 | 691,827 | 10,287,754 | 36,317,429 |
| Sullivan | 3,274 | 2,730 | 49,183 | 122,278 |
| Susquehanna and Wayne | 16,721 | 28,391 | 186,775 | 576,370 |
| Berks, Lebanon, Northampton, and York [2] | | | 110,602 | 121,784 |
| | 2,312,952 | 3,078,767 | 46,099,027 | 180,600,167 |

[1] Value given for shipments is value at which coal left possession of producing company, f. o. b. mines, and does not include margins of separately incorporated sales companies.
[2] Counties producing dredge coal only.

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*Fresh-mined and culm-bank coal, breaker, and washery product.*—Anthracite is now produced from three sources—from mines, from old culm banks, and from the rivers that drain the anthracite region. As all three sources contribute to the country's supply, it is important to consider them all to ascertain the total production. No difficulty is experienced in assembling the figures of production by dredges, as these are separate, distinct operations. A statistical detail requiring particular attention is the occasional practice of putting culm-bank coal through a breaker, either directly from the bank or after preliminary treatment in a washery. The aggregate annual tonnages of culm-bank coal so treated are shown in the last of the following three tables.

TABLE 12.—*Anthracite produced in 1938, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by regions, in net tons*

[Exclusive of change in stock]

| Region and type of plant | From mines | | | From culm banks | From river dredging | Total |
|---|---|---|---|---|---|---|
| | Underground | | Strip pits | | | |
| | Mechanically loaded | Hand-loaded | | | | |
| Lehigh: | | | | | | |
| Breakers | 558,360 | 5,116,748 | 1,965,102 | 53,037 | | 7,693,247 |
| Dredges | | | | | 54,262 | 54,262 |
| Total Lehigh | 558,360 | 5,116,748 | 1,965,102 | 53,037 | 54,262 | 7,747,509 |
| Schuylkill: | | | | | | |
| Breakers | 1,245,117 | 7,898,100 | 2,207,144 | 456,711 | | 11,807,072 |
| Washeries | | 5,833 | 73,274 | 1,485,185 | | 1,564,292 |
| Dredges | | | | | 487,271 | 487,271 |
| Total Schuylkill | 1,245,117 | 7,903,933 | 2,280,418 | 1,941,896 | 487,271 | 13,858,635 |
| Wyoming: | | | | | | |
| Breakers | 8,343,692 | 14,925,264 | 832,629 | 52,212 | | 24,153,797 |
| Washeries | | | 17,192 | 293,299 | | 310,491 |
| Dredges | | | | | 29,491 | 29,491 |
| Total Wyoming | 8,343,692 | 14,925,264 | 849,821 | 345,511 | 29,491 | 24,493,779 |
| Total, excluding Sullivan County: | | | | | | |
| Breakers | 10,147,169 | 27,940,112 | 5,004,875 | 561,960 | | 43,654,116 |
| Washeries | | 5,833 | 90,466 | 1,778,484 | | 1,874,783 |
| Dredges | | | | | 571,024 | 571,024 |
| Total | 10,147,169 | 27,945,945 | 5,095,341 | 2,340,444 | 571,024 | 46,099,923 |
| Sullivan County: Breakers | 4,500 | 44,683 | | | | 49,183 |
| Grand total: 1938 | 10,151,669 | 27,990,628 | 5,095,341 | 2,340,444 | 571,024 | 46,149,106 |
| 1937 | 10,683,837 | 31,882,514 | 5,696,018 | 2,722,599 | 760,474 | 51,745,442 |
| Change, 1938, percent | −5.0 | −12.2 | −10.5 | −14.0 | −24.9 | −10.8 |

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TABLE 13.—*Anthracite produced in 1938, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by fields, in net tons*

[Exclusive of change in stock]

| Field and type of plant | From mines | | | From culm banks | From river dredging | Total |
|---|---|---|---|---|---|---|
| | Underground | | Strip pits | | | |
| | Mechanically loaded | Hand-loaded | | | | |
| Eastern Middle: Breakers | 556,360 | 3,236,328 | 1,404,785 | 10,805 | | 5,208,278 |
| Western Middle: | | | | | | |
| Breakers | 1,211,092 | 6,015,948 | 1,576,273 | 44,174 | | 8,847,487 |
| Washeries | | 5,833 | 73,274 | 861,831 | | 940,938 |
| Dredges | | | | | 223,961 | 223,961 |
| Total Western Middle | 1,211,092 | 6,021,781 | 1,649,547 | 906,005 | 223,961 | 10,012,386 |
| Southern: | | | | | | |
| Breakers | 36,025 | 3,762,572 | 1,191,188 | 454,769 | | 5,444,554 |
| Washeries | | | | 623,354 | | 623,354 |
| Dredges | | | | | 317,572 | 317,572 |
| Total Southern | 36,025 | 3,762,572 | 1,191,188 | 1,078,123 | 317,572 | 6,385,480 |
| Northern: | | | | | | |
| Breakers | 8,343,692 | 14,925,264 | 832,629 | 52,212 | | 24,153,797 |
| Washeries | | | 17,192 | 293,299 | | 310,491 |
| Dredges | | | | | 29,491 | 29,491 |
| Total Northern | 8,343,692 | 14,925,264 | 849,821 | 345,511 | 29,491 | 24,493,779 |
| Total, excluding Sullivan County: | | | | | | |
| Breakers | 10,147,169 | 27,940,112 | 5,004,875 | 561,960 | | 43,654,116 |
| Washeries | | 5,833 | 90,466 | 1,778,484 | | 1,874,783 |
| Dredges | | | | | 571,024 | 571,024 |
| | 10,147,169 | 27,945,945 | 5,095,341 | 2,340,444 | 571,024 | 46,099,923 |
| Sullivan County: Breakers | 4,500 | 44,683 | | | | 49,183 |
| Grand total | 10,151,669 | 27,990,628 | 5,095,341 | 2,340,444 | 571,024 | 46,149,106 |

TABLE 14.—*Culm-bank coal put through breakers, 1934–38, by fields, in net tons*

| Year | Northern | Eastern Middle | Western Middle | Southern | Total [1] |
|---|---|---|---|---|---|
| 1934 | 323,000 | 131,000 | 369,000 | 139,000 | 962,000 |
| 1935 | 236,000 | 143,000 | 61,000 | 177,000 | 617,000 |
| 1936 | 122,000 | 84,000 | 148,000 | 633,000 | 987,000 |
| 1937 | 95,000 | 67,000 | 102,000 | 606,000 | 870,000 |
| 1938 | 52,000 | 11,000 | 44,000 | 455,000 | 562,000 |

[1] No culm-bank coal is put through breakers in Sullivan County.

## SHIPMENTS, BY REGIONS AND SIZES

Shipments of anthracite, by regions and sizes, are given in table 15.

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TABLE 15.—*Pennsylvania anthracite shipped in 1938, by regions and sizes* [1]

| Size | Breaker shipments | | | | | | Washery shipments | Dredge shipments | Grand total |
|---|---|---|---|---|---|---|---|---|---|
| | Lehigh region | Schuylkill region | Wyoming region | Sullivan County | Total | | | | |
| | | | | | Excluding Sullivan County | Including Sullivan County | | | |
| *Net tons* | | | | | | | | | |
| Lump [2] and broken | 26,527 | 41,718 | 54,240 | 2,067 | 122,485 | 124,552 | | | 124,552 |
| Egg | 318,177 | 453,710 | 1,337,144 | | 2,109,031 | 2,109,031 | 2,531 | | 2,111,562 |
| Stove | 1,618,213 | 2,059,946 | 5,558,435 | 1,978 | 9,236,594 | 9,238,572 | 46,630 | | 9,285,202 |
| Chestnut | 1,740,952 | 2,530,792 | 5,872,500 | 4,834 | 10,144,244 | 10,149,078 | 199,587 | | 10,348,665 |
| Pea | 844,511 | 1,182,047 | 2,117,144 | 3,041 | 4,143,702 | 4,146,743 | 189,710 | 74 | 4,336,527 |
| Total domestic | 4,548,380 | 6,268,213 | 14,939,463 | 11,920 | 25,756,056 | 25,767,976 | 438,458 | 74 | 26,206,508 |
| Buckwheat No. 1 | 1,100,019 | 1,747,953 | 2,913,107 | 1,938 | 5,761,079 | 5,763,017 | 390,636 | 5,353 | 6,159,006 |
| Buckwheat No. 2 (rice) | 579,265 | 938,173 | 1,497,822 | 2,696 | 3,015,260 | 3,017,956 | 352,862 | 16,995 | 3,387,813 |
| Buckwheat No. 3 (barley) | 597,864 | 1,146,410 | 1,598,515 | | 3,342,789 | 3,342,789 | 438,691 | 199,075 | 3,980,555 |
| Buckwheat No. 4 | 205,126 | 517,409 | 276,872 | | 999,407 | 999,407 | 58,126 | 129,548 | 1,187,081 |
| Boiler | | | | | | | | | |
| Other | 8,866 | 95,859 | 13,306 | 1,759 | 118,031 | 119,790 | 736 | 22,380 | 142,906 |
| Total steam | 2,491,140 | 4,445,804 | 6,299,622 | 6,393 | 13,236,566 | 13,242,959 | 1,241,051 | 373,351 | 14,857,361 |
| Grand total | 7,039,520 | 10,714,017 | 21,239,085 | 18,313 | 38,992,622 | 39,010,935 | 1,679,509 | 373,425 | 41,063,869 |
| *Value* | | | | | | | | | |
| Lump [2] and broken | $137,120 | $229,268 | $279,803 | $6,200 | $646,191 | $652,391 | | | $652,391 |
| Egg | 1,624,436 | 2,390,888 | 6,903,931 | | 10,919,255 | 10,919,255 | $10,852 | | 10,930,107 |
| Stove | 8,672,515 | 11,094,562 | 29,496,619 | 5,934 | 49,263,696 | 49,269,630 | 221,423 | | 49,491,053 |
| Chestnut | 9,445,879 | 13,689,281 | 31,240,521 | 14,502 | 54,375,681 | 54,390,183 | 843,724 | | 55,233,907 |
| Pea | 3,319,995 | 4,492,533 | 8,284,752 | 7,660 | 16,097,280 | 16,104,940 | 668,674 | $444 | 16,774,058 |
| Total domestic | 23,199,945 | 31,896,532 | 76,205,626 | 34,296 | 131,302,103 | 131,336,399 | 1,744,673 | 444 | 133,081,516 |
| Buckwheat No. 1 | 3,366,851 | 5,119,968 | 8,979,800 | 2,910 | 17,466,619 | 17,469,529 | 1,101,785 | 12,578 | 18,583,892 |
| Buckwheat No. 2 (rice) | 1,365,886 | 2,129,618 | 3,583,395 | 1,340 | 7,078,899 | 7,080,239 | 722,547 | 27,250 | 7,830,036 |
| Buckwheat No. 3 (barley) | 960,023 | 1,714,963 | 2,706,086 | | 5,381,072 | 5,381,072 | 630,877 | 195,133 | 6,207,082 |
| Buckwheat No. 4 | 166,335 | 414,969 | 299,046 | | 880,350 | 880,350 | 46,813 | 84,230 | 1,011,393 |
| Boiler | | | | | | | | | |
| Other | 4,823 | 76,665 | 10,981 | 445 | 92,469 | 92,914 | 405 | 32,326 | 125,645 |
| Total steam | 5,863,918 | 9,456,183 | 15,579,308 | 4,695 | 30,899,409 | 30,904,104 | 2,502,427 | 351,517 | 33,758,048 |
| Grand total | 29,063,863 | 41,352,715 | 91,784,934 | 38,991 | 162,201,512 | 162,240,503 | 4,247,100 | 351,961 | 166,839,564 |

[1] Figures of shipments from breakers include 561,960 tons of culm-bank coal handled in the breakers.
[2] The quantity of lump included is insignificant.

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TABLE 15.—*Pennsylvania anthracite shipped in 1938, by regions and sizes*—Continued

| Size | Breaker shipments | | | | | | Washery shipments | Dredge shipments | Grand total |
|---|---|---|---|---|---|---|---|---|---|
| | Lehigh region | Schuylkill region | Wyoming region | Sullivan County | Total | | | | |
| | | | | | Excluding Sullivan County | Including Sullivan County | | | |
| *Average value per ton* | | | | | | | | | |
| Lump [2] and broken | $5.17 | $5.50 | $5.16 | $3.00 | $5.28 | $5.24 | | | $5.24 |
| Egg | 5.11 | 5.27 | 5.16 | | 5.18 | 5.18 | $4.29 | | 5.18 |
| Stove | 5.36 | 5.39 | 5.31 | 3.00 | 5.33 | 5.33 | 4.75 | | 5.33 |
| Chestnut | 5.43 | 5.41 | 5.32 | 3.00 | 5.36 | 5.36 | 4.23 | | 5.34 |
| Pea | 3.93 | 3.80 | 3.91 | 2.52 | 3.88 | 3.88 | 3.52 | $6.00 | 3.87 |
| Total domestic | 5.10 | 5.09 | 5.10 | 2.88 | 5.10 | 5.10 | 3.98 | 6.00 | 5.08 |
| Buckwheat No. 1 | 3.06 | 2.93 | 3.08 | 1.50 | 3.03 | 3.03 | 2.82 | 2.35 | 3.02 |
| Buckwheat No. 2 (rice) | 2.36 | 2.27 | 2.39 | .50 | 2.35 | 2.35 | 2.05 | 1.60 | 2.31 |
| Buckwheat No. 3 (barley) | 1.61 | 1.50 | 1.69 | | 1.61 | 1.61 | 1.44 | .98 | 1.56 |
| Buckwheat No. 4 | .81 | .80 | 1.08 | | .88 | .88 | .81 | .65 | .85 |
| Boiler | | | | | | | | | |
| Other | .54 | .80 | .83 | .25 | .78 | .78 | .55 | 1.44 | .88 |
| Total steam | 2.35 | 2.13 | 2.47 | .73 | 2.33 | 2.33 | 2.02 | .94 | 2.27 |
| Grand total | 4.13 | 3.86 | 4.32 | 2.13 | 4.16 | 4.16 | 2.53 | .94 | 4.06 |

[2] The quantity of lump included is insignificant.

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Table 16 reveals an interregional variation in the breaker production of domestic sizes as related to that of steam sizes and to total production, which is of great importance to the profitable operation of individual properties. The Wyoming region in 1938 produced 70 percent domestic sizes and 30 percent steam sizes from a given tonnage of breaker feed; the Lehigh region 65 percent domestic and 35 percent steam sizes; and the Schuylkill region 58.5 percent domestic and 41.5 percent steam sizes. These percentages are relatively constant from year to year. The variation among the regions is due to differences in the physical situation and condition of the anthracite beds. Its effect is shown in receipts from sales, as the average sales realization per ton of total domestic sizes has ranged from $2.77 to $3.57 more than that of total steam sizes over the past 3 years. (See table 17.)

TABLE 16.—*Sizes of Pennsylvania anthracite shipped from breakers, 1936–38, by regions, in percent of total*

[Note that shipments of dredge and washery coal are not included]

| Size of coal | Percent of total shipments | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lehigh region | | | Schuylkill region | | | Wyoming region | | |
| | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 |
| Lump [1] and broken | 0.3 | 0.5 | 0.4 | 0.4 | 0.5 | 0.4 | 0.3 | 0.3 | 0.2 |
| Egg | 5.3 | 4.8 | 4.5 | 5.1 | 4.9 | 4.2 | 7.8 | 6.5 | 6.3 |
| Stove | 20.3 | 21.0 | 23.0 | 17.3 | 18.1 | 19.3 | 24.0 | 24.7 | 26.2 |
| Chestnut | 26.3 | 25.6 | 24.7 | 23.8 | 23.0 | 23.6 | 28.0 | 28.1 | 27.6 |
| Pea | 11.4 | 11.5 | 12.0 | 10.7 | 11.0 | 11.0 | 10.0 | 10.4 | 10.0 |
| Total domestic | 63.6 | 63.4 | 64.6 | 57.3 | 57.5 | 58.5 | 70.1 | 70.0 | 70.3 |
| Buckwheat No. 1 | 16.5 | 15.9 | 15.6 | 16.3 | 15.8 | 16.3 | 14.0 | 13.7 | 13.7 |
| Buckwheat No. 2 (rice) | 8.5 | 8.4 | 8.3 | 9.6 | 8.7 | 8.8 | 7.5 | 7.2 | 7.1 |
| Buckwheat No. 3 (barley) | 9.1 | 9.2 | 8.5 | 11.7 | 11.2 | 10.7 | 6.9 | 7.7 | 7.5 |
| Boiler | | | | | | | | | |
| Other, including Buckwheat No. 4 | 2.3 | 3.1 | 3.0 | 5.1 | 6.8 | 5.7 | 1.5 | 1.4 | 1.4 |
| Total steam | 36.4 | 36.6 | 35.4 | 42.7 | 42.5 | 41.5 | 29.9 | 30.0 | 29.7 |

| Size of coal | Sullivan County | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Excluding Sullivan County | | | Including Sullivan County | | |
| Lump [1] and broken | | | 11.3 | 0.4 | 0.4 | 0.3 | 0.3 | 0.4 | 0.3 |
| Egg | 4.0 | 1.8 | | 6.5 | 5.7 | 5.4 | 6.5 | 5.7 | 5.4 |
| Stove | 13.1 | 15.9 | 10.8 | 21.3 | 22.2 | 23.7 | 21.3 | 22.1 | 23.7 |
| Chestnut | 17.3 | 15.8 | 26.4 | 26.4 | 26.2 | 26.0 | 26.4 | 26.2 | 26.0 |
| Pea | 7.9 | 9.5 | 16.6 | 10.4 | 10.7 | 10.6 | 10.4 | 10.8 | 10.6 |
| Total domestic | 42.3 | 43.0 | 65.1 | 65.0 | 65.2 | 66.0 | 64.9 | 65.2 | 66.0 |
| Buckwheat No. 1 | 9.9 | 10.2 | 10.6 | 15.1 | 14.7 | 14.8 | 15.1 | 14.7 | 14.8 |
| Buckwheat No. 2 (rice) | 34.9 | 12.8 | 14.7 | 8.3 | 7.9 | 7.7 | 8.4 | 7.9 | 7.7 |
| Buckwheat No. 3 (barley) | 6.2 | | | 8.8 | 9.0 | 8.6 | 8.8 | 8.9 | 8.6 |
| Boiler | | 2.3 | | | [2] | | | [2] | |
| Other, including Buckwheat No. 4 | 6.7 | 31.7 | 9.6 | 2.8 | 3.2 | 2.9 | 2.8 | 3.3 | 2.9 |
| Total steam | 57.7 | 57.0 | 34.9 | 35.0 | 34.8 | 34.0 | 35.1 | 34.8 | 34.0 |

[1] The quantity of lump included is insignificant.
[2] Less than 0.1 percent.

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## PRICES AND AVERAGE SALES REALIZATION

The circular price of company stove coal, f. o. b. mine, ranged from a low of $5.50 in May to $6.40 in November and December and averaged $6.07 for the 12 months, an advance of 1.5 percent over the 1937 average. Company Buckwheat No. 1 remained at $3.50 throughout the year, an increase of 4.2 percent over 1937. The wholesale price of Chestnut, on tracks at destination, ranged from a low of $8.95 in May to a high of $9.71 in November and December and averaged $9.45 for the year, or 0.9 percent above the average price in 1937. The wholesale price of Pea was 0.7 percent less than in 1937. (See Fig. 2.)

In the spring of 1938 the temporary open-price filing agreement, which had gone into effect in January but had not operated satisfactorily, was susperseded by a new agreement to be administered by an agency not identified with the industry. More than 85 percent of the total production is embraced by the agreement, which, however, did not include illicit coal. The new agreement lasted nominally throughout the rest of the year.

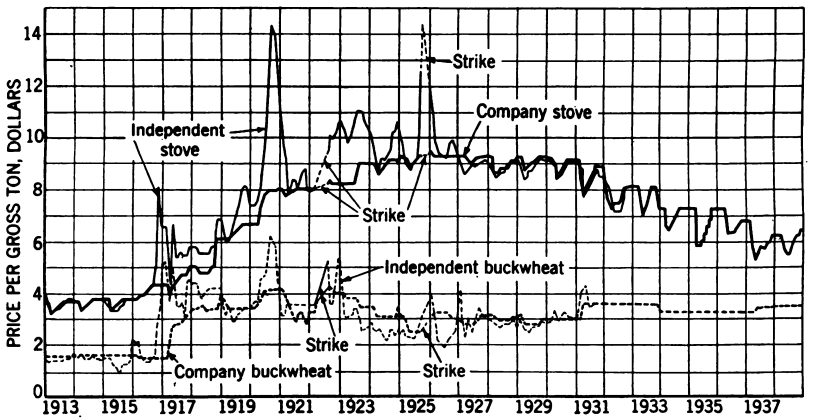


FIGURE 2.—Monthly prices of Pennsylvania anthracite, f. o. b. mine, as quoted by the trade journals, 1913-38. Prices are averages of the range as quoted on the New York market.

The valuation figures in this study represent value at the breaker or washery reported by the operating companies. The company is requested to "estimate value of the product not sold" and to "exclude selling expenses" in making its report.

From this it will be seen that when a producing company sells its output to a separately organized sales company (the practice of many, including certain larger producers), the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal in question is placed on the general market. This fact should be borne in mind in considering the variations in value between different regions shown in the tables for the same sizes of coal.

The average sales realization per net ton on breaker shipments rose to $4.16 in 1938 from $4.03 in 1937. There were small increases in the average realization of all sizes except Pea. (See table 17.)

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If local sales, colliery fuel, washery, and dredge coal are included, the average value per net ton on the total 1938 production is $3.92 compared with $3.81 in 1937. (See table 18.)

TABLE 17.—*Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1936–38, by regions and sizes*

[Value does not include margins of separately incorporated sales companies]

| Size | Lehigh region | | | Schuylkill region | | | Wyoming region | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 |
| Lump [1] and broken | $4.99 | $4.96 | $5.17 | $5.18 | $5.24 | $5.50 | $4.97 | $5.01 | $5.16 |
| Egg | 5.51 | 5.01 | 5.11 | 5.61 | 5.14 | 5.27 | 5.62 | 5.04 | 5.16 |
| Stove | 6.06 | 5.25 | 5.36 | 6.08 | 5.26 | 5.39 | 6.10 | 5.19 | 5.31 |
| Chestnut | 5.92 | 5.25 | 5.43 | 5.94 | 5.31 | 5.41 | 5.89 | 5.20 | 5.32 |
| Pea | 4.39 | 4.04 | 3.93 | 4.23 | 3.96 | 3.80 | 4.30 | 4.02 | 3.91 |
| Total domestic | 5.65 | 5.01 | 5.10 | 5.63 | 5.02 | 5.09 | 5.70 | 5.00 | 5.10 |
| Buckwheat No. 1 | 2.92 | 2.98 | 3.06 | 2.82 | 2.87 | 2.93 | 2.97 | 3.00 | 3.08 |
| Buckwheat No. 2 (rice) [2] | 2.07 | 2.29 | 2.36 | 1.92 | 2.17 | 2.27 | 2.07 | 2.31 | 2.39 |
| Buckwheat No. 3 (barley) | 1.26 | 1.43 | 1.61 | 1.09 | 1.33 | 1.50 | 1.36 | 1.55 | 1.69 |
| Total steam [3] | 2.15 | 2.24 | 2.35 | 1.88 | 1.99 | 2.13 | 2.26 | 2.37 | 2.47 |
| Total all sizes | 4.38 | 3.99 | 4.13 | 4.03 | 3.73 | 3.86 | 4.67 | 4.21 | 4.32 |

| Size | Sullivan County | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Excluding Sullivan County | | | Including Sullivan County | | |
| Lump [1] and broken | | | $3.00 | $5.05 | $5.08 | $5.28 | $5.05 | $5.08 | $5.24 |
| Egg | $4.18 | $3.97 | | 5.60 | 5.06 | 5.18 | 5.60 | 5.06 | 5.18 |
| Stove | 5.74 | 4.46 | 3.00 | 6.09 | 5.21 | 5.33 | 6.09 | 5.21 | 5.33 |
| Chestnut | 4.31 | 3.07 | 3.00 | 5.91 | 5.23 | 5.36 | 5.91 | 5.23 | 5.36 |
| Pea | 3.81 | 2.56 | 2.52 | 4.30 | 4.01 | 3.88 | 4.30 | 4.01 | 3.88 |
| Total domestic | 4.65 | 3.51 | 2.88 | 5.67 | 5.01 | 5.10 | 5.67 | 5.01 | 5.10 |
| Buckwheat No. 1 | 2.62 | 2.00 | 1.50 | 2.91 | 2.95 | 3.03 | 2.91 | 2.95 | 3.03 |
| Buckwheat No. 2 (rice) [2] | 1.47 | .75 | .50 | 2.02 | 2.26 | 2.35 | 2.01 | 2.26 | 2.35 |
| Buckwheat No. 3 (barley) | .97 | | | 1.23 | 1.45 | 1.61 | 1.23 | 1.45 | 1.61 |
| Total steam [3] | 1.52 | 1.03 | .73 | 2.10 | 2.21 | 2.33 | 2.10 | 2.21 | 2.33 |
| Total all sizes | 2.84 | 2.10 | 2.13 | 4.42 | 4.03 | 4.16 | 4.42 | 4.03 | 4.16 |

[1] The quantity of lump included is insignificant. [2] Includes Birdseye. [3] Includes all steam sizes.

TABLE 18.—*Average value per net ton of Pennsylvania anthracite shipped, local sales, colliery fuel, and total production, 1937–38, by regions* [1]

[Note that values in this table include washery and dredge coal]

| Region | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Shipments | Local sales | Colliery fuel | Total production | Shipments | Local sales | Colliery fuel | Total production |
| Lehigh | $3.98 | $4.71 | $1.55 | $3.89 | $4.11 | $4.65 | $1.80 | $4.01 |
| Schuylkill | 3.54 | 2.78 | 1.54 | 3.43 | 3.63 | 3.00 | 1.56 | 3.51 |
| Wyoming | 4.19 | 4.34 | 1.25 | 4.02 | 4.31 | 4.35 | 1.13 | 4.12 |
| Total, excluding Sullivan County | 3.95 | 3.93 | 1.36 | 3.81 | 4.06 | 3.93 | 1.33 | 3.92 |
| Sullivan County | 2.10 | 3.04 | .58 | 2.45 | 2.13 | 2.92 | .83 | 2.49 |
| Grand total | 3.95 | 3.92 | 1.36 | 3.81 | 4.06 | 3.92 | 1.33 | 3.92 |

[1] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated sales companies.

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## NUMBER OF OPERATIONS

The total number of active plants reporting increased from 328 in 1936 to 390 in 1937. (See table 19.) Figures for 1938 are not yet available, but indications are that the upward trend continued.

TABLE 19.—*Number of active operations in the Pennsylvania anthracite industry in 1937* [1]

| Region and type of product | Total active plants reporting [2] | Breakers [3] | Other preparation plants [4] | Washeries [5] | Culm banks operated in conjunction with breakers | Dredges | Reporting strip-pit tonnage |
|---|---|---|---|---|---|---|---|
| Lehigh: | | | | | | | |
| Breakers or mines | 35 | 24 | 1 | | 10 | | 25 |
| Dredges | 1 | | 1 | | | 1 | |
| Total Lehigh | 36 | 24 | 2 | | 10 | 1 | 25 |
| Schuylkill: | | | | | | | |
| Breakers or mines | 75 | 38 | 18 | | 11 | | 36 |
| Washeries | 15 | | | 4 | | | 1 |
| Dredges | 27 | | 22 | | | 27 | |
| Total Schuylkill | 117 | 38 | 40 | 4 | 11 | 27 | 37 |
| Wyoming: | | | | | | | |
| Breakers or mines | 219 | 69 | 4 | | 6 | | 27 |
| Washeries | 12 | | | 2 | | | |
| Dredges | 1 | | 1 | | | 1 | |
| Total Wyoming | 232 | 69 | 5 | 2 | 6 | 1 | 27 |
| Total, excluding Sullivan County: | | | | | | | |
| Breakers | 329 | 131 | 23 | | 27 | | 88 |
| Washeries | 27 | | | 6 | | | 1 |
| Dredges | 29 | | 24 | | | 29 | |
| Total | 385 | 131 | 47 | 6 | 27 | 29 | 89 |
| Sullivan County: Breakers | 5 | 5 | | | | | |
| Grand total | 390 | 136 | 47 | 6 | 27 | 29 | 89 |

[1] Figures for 1938 not yet available.
[2] The number of active plants contains numerous duplications, that is, successions known and unknown, and leases and subleases. Each report received which was tabulated for production or for employment has been counted separately.
[3] Equipped to prepare standard sizes of fresh-mined coal.
[4] For preliminary crushing, screening, or cleaning. Usually old breakers are used for this purpose. The number reported for dredges represents reports showing men employed at tipple.
[5] Preparation plant for the sizing and cleaning of culm-bank coal.

## LABOR STATISTICS

According to the Pennsylvania Department of Mines nearly 97,000 men were employed at anthracite mines in 1938. The number employed in 1937, as based on direct reports from operators and including the employees of dredges and strip contractors, was 99,085.

Man-days lost on account of strikes were 42.5 percent greater in 1937 than in 1936. Suspension of work due to strikes and the number of men involved also were greater in 1937 than in 1936. Comparable statistics covering 1938 are not yet available, but there were no widespread labor disputes during the year.

According to the Bureau of Labor Statistics, average weekly earnings ranged from a low of $14.76 in July to a high of $28.94 in June and averaged $23.40 during 1938, or 7.1 percent below the 1937 average. The index of employment (1929 average equals 100) fluctuated between 37.6 in August and 60.0 in February and averaged 13.1 below 1937. The index of pay rolls reached a low of 20.0 in August and a high of 49.7 in June and averaged 18.6 below 1937.

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TABLE 20.—*Men employed and days worked at operations producing Pennsylvania anthracite in 1937* [1]

[Includes operations of strip contractors]

| Region | Average number of men employed | | | | | | | Average number of days plant operated | Man-days of labor | Average tons per man per day |
|---|---|---|---|---|---|---|---|---|---|---|
| | Underground | | | Surface | | | Grand total | | | |
| | Miners and their laborers | Other | Total underground | In strip pits | In preparation plant | Other | Total surface | | | |
| Lehigh: | | | | | | | | | | |
| Breaker product | 7,167 | 4,002 | 11,169 | 1,629 | 1,333 | 3,066 | 6,028 | 17,197 | 182 | 3,137,357 | 2.67 |
| Dredge product | | | | | 4 | 7 | 11 | 11 | 134 | 1,474 | 20.08 |
| Total Lehigh | 7,167 | 4,002 | 11,169 | 1,629 | 1,337 | 3,073 | 6,039 | 17,208 | 182 | 3,138,831 | 2.68 |
| Schuylkill: | | | | | | | | | | |
| Breaker product | 11,311 | 5,899 | 17,210 | 2,330 | 2,133 | 3,489 | 7,952 | 25,162 | 196 | 4,939,816 | 2.81 |
| Washery product | | | | 65 | 215 | 361 | 641 | 641 | 195 | 124,738 | [2] 13.43 |
| Dredge product | | | | | 91 | 157 | 248 | 248 | 219 | 54,334 | 12.95 |
| Total Schuylkill | 11,311 | 5,899 | 17,210 | 2,395 | 2,439 | 4,007 | 8,841 | 26,051 | 196 | 5,118,888 | 3.18 |
| Wyoming: | | | | | | | | | | |
| Breaker product | 31,852 | 13,865 | 45,717 | 561 | 2,578 | 6,475 | 9,614 | 55,331 | 188 | 10,421,645 | 2.56 |
| Washery product | | | | | 35 | 25 | 60 | 60 | 137 | 8,242 | [2] 15.24 |
| Dredge product | | | | | 16 | 8 | 24 | 24 | 194 | 4,656 | 5.91 |
| Total Wyoming | 31,852 | 13,865 | 45,717 | 561 | 2,629 | 6,508 | 9,698 | 55,415 | 188 | 10,434,543 | 2.60 |
| Total, excluding Sullivan County: | | | | | | | | | | |
| Breaker product | 50,330 | 23,766 | 74,096 | 4,520 | 6,044 | 13,030 | 23,594 | [3] 97,690 | 189 | 18,498,818 | 2.65 |
| Washery product | | | | 65 | 250 | 386 | 701 | 701 | 190 | 132,980 | [2] 13.54 |
| Dredge product | | | | | 111 | 172 | 283 | 283 | 214 | 60,464 | 12.58 |
| Total | 50,330 | 23,766 | 74,096 | 4,585 | 6,405 | 13,588 | 24,578 | 98,674 | 189 | 18,692,262 | 2.77 |
| Sullivan County: Breaker product | 214 | 85 | 299 | | 31 | 81 | 112 | 411 | 118 | 48,497 | 1.82 |
| Grand total | 50,544 | 23,851 | 74,395 | 4,585 | 6,436 | 13,669 | 24,690 | 99,085 | 189 | 18,740,759 | 2.77 |

[1] Figures for 1938 not yet available.
[2] Represents washeries for which both production and employment were separately reported.
[3] The men shown for "breaker product" include a considerable number of washery employees who could not be separated from breaker employees.

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TABLE 21.—*Men employed at operations producing Pennsylvania anthracite in 1937, by counties* [1]

[Includes operations of strip contractors]

| County | Men | County | Men |
|---|---|---|---|
| Carbon | 4,134 | Schuylkill | 20,697 |
| Columbia | 977 | Sullivan | 411 |
| Dauphin | 1,035 | Susquehanna and Wayne | 314 |
| Lackawanna | 18,584 | Berks, Lebanon, Northampton, and York[2] | 42 |
| Luzerne | 44,716 | | |
| Northumberland | 8,175 | | 99,085 |

[1] Figures for 1938 not yet available.
[2] Counties producing dredge coal only.

TABLE 22.—*Strikes, suspensions, and lock-outs in the Pennsylvania anthracite region in 1937* [1]

| | Lehigh | Schuylkill | Wyoming | Sullivan County | Total | |
|---|---|---|---|---|---|---|
| | | | | | Excluding Sullivan County | Including Sullivan County |
| Total number employed | 17,208 | 26,051 | 55,415 | 411 | 98,674 | 99,085 |
| Men on strike | 10,139 | 14,614 | 9,593 | ---------- | 34,346 | 34,346 |
| Man-days lost on account of strike | 294,449 | 209,962 | 76,051 | ---------- | 580,462 | 580,462 |
| Average days lost— | | | | | | |
| Per man employed | 17.1 | 8.1 | 1.4 | ---------- | 5.9 | 5.9 |
| Per man on strike | 29.0 | 14.4 | 7.9 | ---------- | 16.9 | 16.9 |

[1] Figures for 1938 not yet available.

## EQUIPMENT AND METHODS OF MINING

*Mechanical loading.*—Anthracite loaded mechanically underground continued to represent about one-fourth of the total deep-mined production. In 1938 the 10,151,669 tons so loaded were 26.6 percent of the total underground output compared with 25 percent (10,684,000 tons) in 1937 and 24.2 percent (10,827,946 tons) in 1936. The 5-percent decline in tonnage loaded mechanically from 1937 to 1938 was slight compared with the 12.2-percent decrease in quantity loaded by hand and the 11.1-percent drop in total tonnage.

In 1938 sales of both scrapers and conveyors in the Pennsylvania anthracite region were below the 1937 figures. Sales of scrapers declined from 16 in 1937 to 4 in 1938 and of conveyors (including hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads) from 260 to 241 units. No sales of mobile loading machines were reported.

The number of scrapers in use increased from 539 in 1937 to 545 in 1938, but the number of pit-carloaders and conveyors (with duckbills and other self-loading heads and hand-loaded) dropped from 1,855 to 1,831. These figures include the limited mobile-loading equipment reported in the field, as shown in table 24.

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TABLE 23.—*Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1934–38*

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

| Year | Net tons | | | Index numbers, 1927=100 | | |
|---|---|---|---|---|---|---|
| | Mechanical loading underground | Stripping | Hand loading | Mechanical loading underground | Stripping | Hand loading |
| 1934 | 9,284,000 | 5,798,000 | 39,290,000 | 418 | 269 | 55 |
| 1935 | 9,279,000 | 5,187,000 | 34,400,000 | 417 | 241 | 48 |
| 1936 | 10,828,000 | 6,203,000 | 33,899,000 | 487 | 288 | 47 |
| 1937 | 10,684,000 | 5,696,000 | 31,883,000 | 481 | 265 | 45 |
| 1938 | 10,152,000 | 5,095,000 | 27,990,000 | 457 | 237 | 39 |

TABLE 24.—*Pennsylvania anthracite loaded mechanically underground, 1934–38*

| Year | Scrapers | | Conveyors and pit-car loaders [1] | | Total loaded mechanically | |
|---|---|---|---|---|---|---|
| | Number of units | Net tons loaded | Number of units | Net tons handled | Number of units | Net tons handled |
| 1934 | [2] 531 | [2] 3,017,741 | 1,376 | 6,266,745 | 1,907 | 9,284,486 |
| 1935 | [2] 508 | [2] 2,662,026 | 1,615 | 6,617,031 | 2,123 | 9,279,057 |
| 1936 | [2] 504 | [2] 2,966,407 | 1,790 | 7,861,539 | 2,294 | 10,827,946 |
| 1937 | 539 | 2,873,289 | [2] 1,855 | [2] 7,810,548 | 2,394 | 10,683,837 |
| 1938 | 545 | 2,589,954 | [2] 1,831 | [2] 7,561,715 | 2,376 | 10,151,669 |

[1] Includes duckbills and other self-loading conveyors, which account for only a small part of the total.
[2] Includes mobile loaders.

TABLE 25.—*Pennsylvania anthracite handled by mobile loaders and scrapers and by all types of conveyors in 1938, by fields, in net tons*

| Field | Scraper loaders | Pit-car loaders | Hand-loaded face conveyors, all types [1] | Total mechanically loaded underground |
|---|---|---|---|---|
| Northern | 2,153,164 | ---------- | 6,195,028 | 8,348,192 |
| Eastern Middle | 114,034 | 25,620 | 416,706 | 556,360 |
| Western Middle | 322,756 | 7,681 | 890,180 | 1,211,092 |
| Southern | | | [2] 26,500 | 36,025 |
| | 2,589,954 | 33,301 | 7,528,414 | 10,151,669 |

[1] Shaker chutes, etc., including those equipped with duckbills.
[2] Includes tonnage by mobile loaders.

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*Cutting machines.*—The number of cutting machines in use in 1938 was greater than in 1937, but the tonnage cut by machine was less.

TABLE 26.—*Pennsylvania anthracite cut by machines, 1937–38*

| Region | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Cutting machines | | Net tons cut by machines | Cutting machines | | Net tons cut by machines |
| | Permissible | All other types | | Permissible | All other types | |
| Lehigh | | | | | | |
| Schuylkill | 3 | 3 | 41,149 | | | |
| Wyoming | 137 | 75 | 1,911,149 | 150 | 89 | 1,583,907 |
| Total, excluding Sullivan County | 140 | 78 | 1,952,298 | 150 | 89 | 1,583,907 |
| Sullivan County | 2 | 3 | 32,214 | | 3 | 4,500 |
| Grand total | 142 | 81 | 1,984,512 | 150 | 92 | 1,588,407 |

*Strip-pit mining.*—The percentage of anthracite produced from strip pits compared with fresh-mined anthracite remained virtually constant—11.8 percent in 1938 and 11.9 percent in 1937. The tonnage mined by this method in 1938 fell slightly in the Lehigh region and 25 percent in the Schuylkill region but increased 34 percent in the Wyoming region. Table 27 gives the figures for several years.

TABLE 27.—*Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1936–38, in net tons*

| Year | Number of power shovels in use [1] | Quantity mined by stripping | | Percent of fresh-mined total that was stripped | Number of men employed | Average number of days worked |
|---|---|---|---|---|---|---|
| | | Total | Average per shovel | | | |
| 1915 | 57 | 1,121,603 | 19,677 | [2] | [2] | [2] |
| 1920 | 96 | 2,054,441 | 21,400 | 2.5 | [2] | [2] |
| 1925 | 97 | 1,578,478 | 16,273 | 2.7 | [2] | [2] |
| 1930 | 108 | 2,526,288 | 23,484 | 3.7 | [2] | [2] |
| 1936 | 364 | 6,203,267 | 17,042 | 12.2 | 4,667 | 199 |
| 1937 | 351 | 5,696,018 | 16,228 | 11.9 | 4,585 | 184 |
| 1938: | | | | | | |
| Lehigh region | 123 | 1,965,102 | 15,976 | 25.7 | [2] | [2] |
| Schuylkill region | 119 | 2,280,418 | 19,163 | 20.0 | [2] | [2] |
| Wyoming region | 89 | 849,821 | 9,549 | 3.5 | [2] | [2] |
| Total, 1938 [3] | [4] 331 | 5,095,341 | 15,394 | 11.8 | [2] | [2] |

[1] Certain of the equipment reported by stripping contractors may have been counted twice when moved from one small job to another during the year. The amount of such double counting is unknown but presumably is not great.
[2] Data not available.
[3] There was no strip-pit mining in Sullivan County during 1938.
[4] Incudes 102 gasoline, 22 steam, 64 electric, 133 Diesel, and 10 other types of shovels.

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*Dredge operations.*—Both the tonnage and average value of anthracite produced by dredges declined in 1938 compared with 1937.

TABLE 28.—*Anthracite produced by dredges, 1937–38, by rivers*

| River (including tributaries) | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Dredges | Net tons | Value | Dredges | Net tons | Value |
| Lehigh, Schuylkill | 4 | 95,065 | $96,089 | 5 | 123,452 | $124,795 |
| Susquehanna | 25 | 665,409 | 745,963 | 29 | 447,572 | 445,784 |
| | 29 | 760,474 | 842,052 | 34 | 571,024 | 570,579 |

TABLE 29.—*Average receipts per net ton on all dredge coal sold, 1933–38*

| Year | Average receipts | Year | Average receipts |
|---|---|---|---|
| 1933 | $0.84 | 1936 | $1.06 |
| 1934 | .98 | 1937 | 1.11 |
| 1935 | .88 | 1938 | 1.00 |

## FOREIGN TRADE [4]

*Imports.*—Imports of anthracite declined from 395,737 tons in 1937 to 362,895 in 1938, or 8.3 percent. In 1938 imports were equivalent to 19 percent of exports compared with 21 percent in 1937.

TABLE 30.—*Anthracite imported for consumption in the United States, 1937–38, by countries, in net tons*

| Country | 1937 | 1938 | Country | 1937 | 1938 |
|---|---|---|---|---|---|
| Canada | 4,308 | 2,487 | United Kingdom | 124,983 | 154,104 |
| Indochina | | 5,824 | | | |
| U. S. S. R. | 266,446 | 200,480 | | 395,737 | 362,895 |

TABLE 31.—*Anthracite imported for consumption in the United States, 1937–38, by customs districts, in net tons*

| Customs district | 1937 | 1938 | Customs district | 1937 | 1938 |
|---|---|---|---|---|---|
| Buffalo | 425 | | Michigan | | 29 |
| Connecticut | 12,611 | 11,320 | Rhode Island | 62,551 | 54,642 |
| Maine and New Hampshire | 32,766 | 32,436 | Vermont | | 3 |
| Massachusetts | 287,384 | 264,465 | | 395,737 | 362,895 |

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Exports.*—Exports of anthracite totaled 1,908,911 tons in 1938 compared with 1,914,173 tons in 1937, a decline of 0.3 percent.

TABLE 32.—*Anthracite exported from the United States, 1937–38, by countries, in net tons*

| Country | 1937 | 1938 | Country | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | South America: | | |
| Bermuda | 1,652 | 1,175 | Bolivia | | 265 |
| Canada | 1,893,334 | 1,895,718 | Brazil | 224 | 672 |
| Central America: | | | Colombia | 14 | 3 |
| British Honduras | 1 | | Guiana: | | |
| Guatemala | 4 | 13 | British | 270 | |
| Honduras | 64 | | Surinam | 11 | |
| Nicaragua | 1 | 22 | Peru | 1 | |
| Panama | 44 | 1 | Venezuela | 10 | 15 |
| Mexico | 373 | 179 | Europe: | | |
| Miquelon and St. Pierre Islands | | 45 | France | 56 | 8 |
| Newfoundland and Labrador | 15,280 | 7,471 | United Kingdom | 2 | |
| West Indies: | | | Asia: | | |
| British: | | | Japan | | 149 |
| Barbados | 58 | | Saudi Arabia | | 1 |
| Jamaica | | 11 | Africa: Mozambique | 1,155 | |
| Trinidad and Tobago | | 22 | | 1,914,173 | 1,908,911 |
| Other British | 214 | 268 | | | |
| Cuba | 1,317 | | | | |
| Dominican Republic | 1 | 2 | | | |
| French | | 2,865 | | | |
| Haiti | 30 | | | | |
| Netherland | 57 | 6 | | | |

TABLE 33.—*Anthracite exported from the United States, 1937–38, by customs districts and ports of export, in net tons*

| Customs district | 1937 | 1938 | Customs district | 1937 | 1938 |
|---|---|---|---|---|---|
| North Atlantic: | | | Pacific Coast: | | |
| Maine and New Hampshire | 79 | 20 | Alaska | 45 | 269 |
| Massachusetts | 40 | 294 | Los Angeles | 3 | 149 |
| New York | 28,861 | 33,756 | San Diego | 77 | 12 |
| Philadelphia | 23,531 | 34,908 | San Francisco | 31 | 8 |
| South Atlantic: | | | Washington | 279 | |
| Maryland | 5,004 | 459 | Northern Border: | | |
| Virginia | | 2,865 | Buffalo | 1,308,775 | 1,273,807 |
| Gulf Coast: | | | Dakota | 922 | 379 |
| Florida | 71 | 81 | Duluth and Superior | 5,093 | 4,234 |
| Mobile | 281 | | Michigan | 3,013 | 4 |
| New Orleans | 66 | 6 | Ohio | 16,883 | 5,068 |
| Mexican border: | | | Rochester | 150,933 | 165,853 |
| Arizona | 56 | 59 | St. Lawrence | 369,220 | 385,011 |
| El Paso | 203 | 108 | Vermont | 704 | 1,561 |
| San Antonio | 2 | | Miscellaneous: Virgin Islands | 1 | |
| | | | | 1,914,173 | 1,908,911 |

*The Canadian market.*—In 1937 and 1938, 56 and 53 percent, respectively, of Canadian imports of anthracite came from the United States. Not since 1932 had Pennsylvania anthracite occupied so favorable a position over competitors in the Canadian market. Bituminous coal imported into Canada from the United States in 1938 maintained its usual high percentage, but there was a marked decline in tonnage from 1937.

Complete data on fuel and power consumption in Canada in 1938 are not available, but indications point to a decline in coal and lignite production and a decided drop in imports compared to 1937.

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The trend toward increased consumption of natural gas, fuel oils, and water power in recent years was continued in 1937 and 1938. The total mineral fuels and water power, in terms of coal, available in 1937 will considerably exceed the figure for 1936 [5] and may reach that for the peak year 1929, but a marked decrease in available coal in 1938 may depress the aggregate consumption of these power resources for the country to the 1928 and 1936 levels, or to the equivalent of about 50,000,000 tons of coal. The following table gives data on the coal and coke industry and trade of Canada in 1937 and 1938.

TABLE 34.—*Coal and coke industry and foreign trade of Canada, 1937–38* [1]

[Thousands of net tons]

| | Anthracite | | Bituminous | | Subbituminous | | Lignite | | Total coal | | Coke from coal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 |
| Production | ------ | ------ | 11,635 | 10,289 | 506 | 489 | 3,695 | 3,470 | 15,836 | 14,248 | 2,570 | 2,356 |
| Imports: | | | | | | | | | | | | |
| United States | 1,995 | 1,974 | 12,339 | 9,644 | ------ | ------ | 1 | 3 | 14,335 | 11,621 | 405 | 407 |
| Great Britain | 1,135 | 1,199 | 56 | 66 | ------ | ------ | ------ | ------ | 1,191 | 1,265 | 4 | 3 |
| Germany | 274 | 407 | 54 | 35 | ------ | ------ | ------ | ------ | 328 | 442 | 9 | 5 |
| Belgium | 8 | 34 | ------ | ------ | ------ | ------ | ------ | ------ | 8 | 34 | ------ | ------ |
| French Indochina | ------ | 30 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 30 | ------ | ------ |
| Netherlands | ------ | 37 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 37 | ------ | ------ |
| U. S. S. R. | 161 | 15 | ------ | ------ | ------ | ------ | ------ | ------ | 161 | 15 | ------ | ------ |
| Morocco | ------ | 20 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 20 | ------ | ------ |
| Total imports | 3,573 | 3,716 | 12,449 | 9,745 | ------ | ------ | 1 | 3 | 16,023 | 13,464 | 418 | 415 |
| Exports | ------ | ------ | 345 | 344 | ------ | ------ | 10 | 9 | 355 | 353 | 37 | 31 |
| Available for consumption | 3,573 | 3,716 | 23,739 | 19,690 | 506 | 489 | 3,686 | 3,464 | 31,504 | 27,359 | 2,951 | 2,740 |

[1] Coal statistics for 1937 are from Coal Statistics for Canada for the Calendar Year 1937, p. 29, Table 29. Coal statistics for 1938 are from Quarterly Coal and Coke Statistics for Canada, October–December 1938, pp. 4, 5, and 14. Coke statistics are from Quarterly Coal and Coke Statistics, October–December 1937, p. 13, and October–December 1938, pp. 14 and 16. Canadian coal charged to ovens in 1937, 1,162,247 tons; 1938, 1,064,302 tons. Imported coal charged to ovens in 1937, 2,415,095 tons; 1938, 2,215,469 tons.

Preliminary figures, in terms of coal, show that Canadian consumption of natural gas increased from 1,125,000 tons in 1936 to 1,295,000 tons in 1937 and 1,326,000 tons in 1938, and that of fuel and gas oils from 3,259,000 tons in 1936 to 3,539,000 tons in 1937.

Apparently there is a wide variation in the prices paid by Canadian importers for anthracite. The invoice value is based on the fair market value or price of anthracite sold for home consumption in the principal markets of the country of origin at the time shipment is made, but the value must not be less than the price to jobbers and wholesalers generally nor less than the actual cost of production at the time of shipment, plus a reasonable advance for cost of selling and profit.

In 1937 and 1938, respectively, the price per net ton for domestic sizes, except Pea, of anthracite from Great Britain was reported as $5.37 and $5.83; from the United States, $5.62 and $5.74; from Germany, $4.27 and $4.33; and from the U. S. S. R., $2.37 and $4.54.[6]

As the United States is the source of virtually all the bituminous coal imported into Canada the extent of Canadian subventions in aid of its coal industry is of interest. The tonnage of Canadian coal

[5] Minerals Yearbook. 1938, p. 754.
[6] Trade of Canada, Calendar Year 1938, p. 408.

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moved under assisted (railroad) rates amounted to 146,000 net tons in 1928, reached 1,149,000 tons in 1932, and was 2,182,000, 2,356,000, and 2,637,000 net tons in 1935, 1936, and 1937. Of the 1937 tonnage, 1,909,000 tons came from Nova Scotia and most of the remainder from Alberta, Saskatchewan, and British Columbia.[7]

It is understood that a further increase in subventions was granted the Nova Scotia industry late in 1938, in which year the cost of the subsidies totaled $1,858,000.

[7] Coal Statistics for Canada, 1937, p. 105

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# COKE AND BYPRODUCTS [1]

By H. L. BENNIT

## SUMMARY OUTLINE


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The coke industry shared the general business recession of 1938. Outstanding in the record of coke production during the year was the fact that for the first time since 1932 output failed to increase over that of the preceding year.

Total output from byproduct and beehive ovens in 1938 fell from 52,375,469 to 32,633,304 tons, a decrease of 19,742,165 tons or nearly 38 percent from 1937. Compared with the peak year 1929 when output totaled 59,883,845 tons, the decrease was more than 45 percent.

Of the total production in 1938 byproduct ovens contributed 31,795,892 tons (97.4 percent) and beehive ovens 837,412 tons (2.6 percent). At byproduct plants output decreased from 49,210,748 tons in 1937 to 31,795,892 in 1938, a loss of 17,414,856 tons (35.4 percent). The bulk of this decline occurred at "furnace" coke plants, where output, reflecting the drastic curtailment at blast-furnace operations, dropped 43 percent. At merchant plants (including public utility plants operating byproduct-coke ovens), output declined only 15 percent. The difference in the rate of decrease is explained by the difference in stability of the markets supplied by the two classes of plants. The greater part of the output of furnace plants is used in blast furnaces, which were affected much more by the industrial recession than the coke industry as a whole.

The trend of activity in the coke industry during 1938 was represented by two distinctly opposite movements. The first 6 months were characterized by continuation of the sharp downward curve that began in September 1937 and terminated with a low production point of 2,116,300 tons in June 1938; a definite upward movement followed,

[1] Data for byproduct coke in 1938 are preliminary: for beehive coke they are final. Detailed statistics with final revisions will be released later.



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and output climbed steadily to a high point of 3,438,400 tons in December. Production in the latter half of 1938 exceeded that of the first half by more than 2,000,000 tons.

An adequate supply of byproduct coke for furnace use checked the beehive-coke "boomlet" that flourished throughout 1937 until the last 2 months of the year. Beginning with a production of 114,100 tons in January 1938 and ending with an output of only 75,600 tons in December the yearly total of 837,400 tons decreased 74 percent from 1937.

Stocks of byproduct coke, which ordinarily rise as production falls, were up 1,090,374 tons (43 percent) by the end of the year; at merchant plants the increase was 57 percent, while at furnace plants stock piles rose only 24 percent. At the average daily rate of production throughout the year reserves at the end of December would have sufficed for a little more than 41 days. Supplies of coking coal in stock at byproduct plants showed only seasonal variation during the year, the quantity on hand at the end of the year—7,462,163 tons—being less than 3 percent over the 1937 total.

Imports for consumption declined 53 percent and exports 8 percent, the indicated consumption of all coke being 39 percent less than in 1937.

Shipments of all coke by rail throughout the country dropped 46 percent below the 1937 level, while the volume of river commerce via the Allegheny River decreased 47 percent, via the Monongahela River 31 percent, and via the Ohio River 17 percent.

A selected list of retail dealers reported that deliveries were 40 percent under 1937, while stocks at the same yards decreased 22 percent.

Circular prices for the various grades of coke, quoted by trade journals, showed a rising tendency in general, the only important exception being a decline in the asking price of Connellsville furnace coke. Actual reports received from operators of beehive coke plants indicate a slight increase in total sales-realization averages.

In the field of byproducts, the only statistics available for 1938 cover ammonia and benzol; production data for these commodities indicate decreases of 30 and 39 percent, respectively, from 1937.

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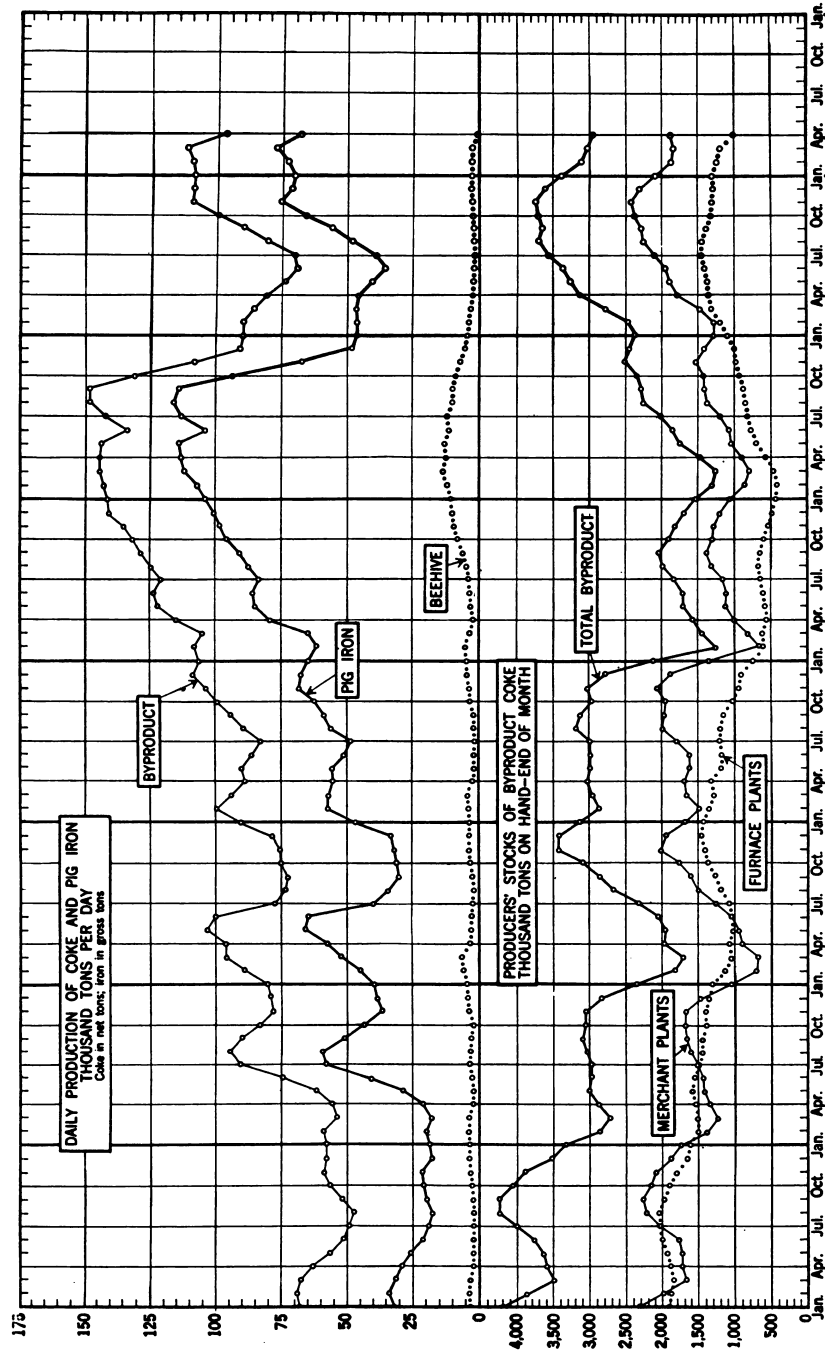


FIGURE 1.—Average daily production of beehive and byproduct coke and pig iron; and producers' stocks of byproduct coke, 1932-39, by months.

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TABLE 1.—*Salient statistics of the coke industry in 1937* [1]

| | Byproduct | Beehive | Total |
|---|---|---|---|
| Coke produced: | | | |
| At merchant plants: | | | |
| Quantity—net tons | 13,076,539 | | 13,076,539 |
| Value | $84,334,632 | | $84,334,632 |
| At furnace plants: | | | |
| Quantity—net tons | 36,134,209 | | 36,134,209 |
| Value | $163,021,120 | | $163,021,120 |
| Total: | | | |
| Quantity—net tons | 49,210,748 | 3,164,721 | 52,375,469 |
| Value | $247,355,752 | $13,648,151 | $261,003,903 |
| Screenings or breeze produced: | | | |
| Quantity—net tons | 3,883,698 | 101,057 | 3,984,755 |
| Value | $7,954,608 | $133,060 | $8,087,668 |
| Coal charged into ovens: | | | |
| Quantity—net tons | 69,575,373 | 4,926,824 | 74,502,197 |
| Value | $260,453,698 | $9,886,416 | $270,340,114 |
| Average value per ton | $3.74 | $2.01 | $3.63 |
| Average yield in percent of coal charged: | | | |
| Coke | 70.73 | 64.23 | 70.30 |
| Breeze (at plants actually recovering) | 5.58 | 4.21 | 5.54 |
| Ovens: | | | |
| In existence Jan. 1 | 12,849 | 13,012 | 25,861 |
| In existence Dec. 31 | 12,718 | 12,194 | 24,912 |
| Dismantled during year | 483 | 749 | 1,232 |
| In course of construction Dec. 31 | 259 | | 259 |
| Daily capacity of ovens Dec. 31 | 171,855 | (2) | (2) |
| Coke used by operator: | | | |
| In blast furnaces: | | | |
| Quantity—net tons | 30,418,919 | 262,394 | 30,681,313 |
| Value | $134,820,212 | $1,389,449 | $136,209,661 |
| To make producer or water gas: | | | |
| Quantity—net tons | 1,281,965 | | 1,281,965 |
| Value | $6,733,272 | | $6,733,272 |
| For other purposes: | | | |
| Quantity—net tons | 529,013 | 1,516 | 530,529 |
| Value | $2,744,853 | $6,996 | $2,751,849 |
| Disposition of coke: | | | |
| Sold to financially affiliated corporations: | | | |
| For blast-furnace use: | | | |
| Quantity—net tons | 2,691,390 | 405,661 | 3,097,051 |
| Value | $12,209,263 | $1,661,596 | $13,870,859 |
| For all other purposes: | | | |
| Quantity—net tons | 734,056 | 4,204 | 738,260 |
| Value | $4,360,297 | $21,874 | $4,382,171 |
| Sold to other consumers: | | | |
| For blast-furnace use: | | | |
| Quantity—net tons | 1,620,182 | 1,353,423 | 2,973,605 |
| Value | $7,027,340 | $5,518,733 | $12,546,073 |
| For foundry use: | | | |
| Quantity—net tons | 1,700,405 | 338,417 | 2,038,822 |
| Value | $14,403,621 | $1,729,632 | $16,133,253 |
| For manufacture of water gas: | | | |
| Quantity—net tons | 470,394 | 92,039 | 562,433 |
| Value | $3,145,958 | $369,969 | $3,515,927 |
| For other industrial use: | | | |
| Quantity—net tons | 1,125,896 | 358,811 | 1,484,707 |
| Value | $6,554,681 | $1,587,854 | $8,142,535 |
| For domestic use: | | | |
| Quantity—net tons | 7,807,792 | 299,726 | 8,107,518 |
| Value | $50,997,240 | $1,166,039 | $52,163,279 |
| Disposition of screenings or breeze: | | | |
| Used by operator: | | | |
| For raising steam: | | | |
| Quantity—net tons | 2,754,533 | 5,786 | 2,760,319 |
| Value | $5,223,096 | $7,514 | $5,230,610 |
| To make producer or water gas: | | | |
| Quantity—net tons | 79,566 | | 79,566 |
| Value | $292,872 | | $292,872 |
| For other purposes: | | | |
| Quantity—net tons | 371,533 | 2,393 | 373,926 |
| Value | $719,621 | $1,489 | $721,110 |
| Sold: | | | |
| Quantity—net tons | 657,145 | 53,090 | 710,235 |
| Value | $1,535,137 | $73,322 | $1,608,459 |
| Average receipts per ton sold: | | | |
| Furnace coke (merchant sales) | $4.34 | $4.08 | $4.22 |
| Foundry coke | $8.47 | $5.11 | $7.91 |
| Domestic coke | $6.53 | $3.89 | $6.43 |
| For manufacture of water gas | $6.69 | $4.02 | $6.25 |
| Other industrial coke | $5.82 | $4.43 | $5.48 |
| Screenings or breeze | $2.34 | $1.38 | $2.26 |

[1] Figures for 1938 not yet available.

[2] Data not available.

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TABLE 1.—*Salient statistics of the coke industry in 1937*—Continued

| | Byproduct | Beehive | Total |
|---|---|---|---|
| Stocks on hand on Jan. 1, 1938: | | | |
| Furnace, net tons | 610,840 | 13,542 | 624,382 |
| Foundry, do | 29,828 | 13,264 | 43,092 |
| Domestic and other, do | 1,878,652 | 49,161 | 1,927,813 |
| Breeze, do | 277,367 | 7,166 | 284,533 |
| Exports, do | | | 526,683 |
| Imports, do | | | 286,364 |
| Calculated consumption, do | | | 51,271,929 |
| Byproducts produced: | | | |
| Gas, M cubic feet | 757,628,942 | | 757,628,942 |
| Wasted, percent | 1.84 | | 1.84 |
| Burned in coking process, do | 37.04 | | 37.04 |
| Surplus sold or used, do | 61.12 | | 61.12 |
| Tar, gallons | 603,053,288 | | 603,053,288 |
| Ammonium sulfate or equivalent, pounds | 1,506,431,251 | | 1,506,431,251 |
| Crude light oil, gallons | 187,054,346 | | 187,054,346 |
| Yield of byproducts per ton of coal: | | | |
| Gas, M cubic feet | 10.89 | | 10.89 |
| Tar, gallons | 8.67 | | 8.67 |
| Ammonium sulfate or equivalent, pounds | 21.84 | | 21.84 |
| Crude light oil, gallons | 2.86 | | 2.86 |
| Value of byproducts sold: | | | |
| Gas (surplus) | $72,961,697 | | $72,961,697 |
| Tar: | | | |
| Sold | $18,456,483 | | $18,456,483 |
| Used by producer | $10,490,075 | | $10,490,075 |
| Ammonium sulfate or equivalent | $16,048,325 | | $16,048,325 |
| Crude light oil and derivatives | $20,215,404 | | $20,215,404 |
| Other byproducts [3] | $4,442,929 | | $4,442,929 |
| Total value of coke, breeze, and byproducts [4] | $397,925,273 | $13,781,211 | $411,706,484 |

[3] Includes naphthalene and tar derivatives.
[4] Includes value of tar used by coke plants.

TABLE 2.—*Statistical trends of the coke industry, 1923 and 1935–38*

| | 1923 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Coke produced: | | | | | |
| Beehive, net tons | 19,379,870 | 917,208 | 1,706,063 | 3,164,721 | 837,412 |
| Byproduct, do | 37,597,664 | 34,224,053 | 44,569,121 | 49,210,748 | 31,795,892 |
| Total, do | 56,977,534 | 35,141,261 | 46,275,184 | 52,375,469 | 32,633,304 |
| Percent of total from byproduct ovens | 66.0 | 97.4 | 96.3 | 94.0 | 97.4 |
| Stocks of producers, end of year, all coke, net tons | [2] 1,221,737 | 2,829,384 | 1,732,066 | 2,595,287 | 3,654,625 |
| Exports, all coke, do | 1,237,342 | 613,975 | 670,312 | 526,683 | 486,571 |
| Imports, all coke [3], do | 85,002 | 317,379 | 329,957 | 286,364 | 135,240 |
| Consumption, calculated, all coke, do | 55,173,457 | 35,613,824 | 47,032,147 | 51,271,929 | 31,222,635 |
| Disposal of coke (beehive and byproduct): | | | | | |
| Furnace coke (including all coke used by producer), net tons | 47,774,408 | 22,586,613 | [4] 30,772,156 | 36,751,969 | ([5]) |
| Foundry coke, do | 3,600,719 | 1,484,453 | 1,921,817 | 2,038,822 | ([5]) |
| Other industrial (including water gas), net tons | 2,283,888 | 2,236,112 | 2,032,774 | 2,047,140 | ([5]) |
| Domestic coke, do | 2,733,414 | 9,426,386 | 10,021,343 | 8,107,518 | 7,193,306 |
| Ovens: | | | | | |
| Beehive, in existence, end of year | 62,349 | 13,674 | 13,012 | 12,194 | 10,816 |
| Byproduct, in existence, end of year | 11,156 | 12,860 | 12,849 | 12,718 | ([5]) |
| Byproduct under construction, end of year | 629 | 122 | 305 | 259 | 130 |
| Cost of coal charged, byproduct ovens, average per ton | $4.76 | $3.82 | $3.69 | $3.74 | ([5]) |
| Prices of coke: | | | | | |
| Average spot price of Connellsville furnace coke, f. o. b. ovens | $5.33 | $3.61 | $3.68 | $4.29 | $3.86 |
| Average realization on byproduct coke sold: | | | | | |
| Furnace coke (merchant sales) | $6.74 | $4.77 | $5.09 | $4.34 | ([5]) |
| Foundry coke | $10.54 | $6.96 | $7.44 | $8.47 | ([5]) |
| Other industrial (including water gas) | $9.06 | $5.41 | $5.51 | $6.08 | ([5]) |
| Domestic | $9.05 | $5.84 | $6.07 | $6.53 | ([5]) |

[1] Subject to revision.
[2] Furnace and foundry coke only.
[3] Prior to 1934 the figures represent general imports; beginning with 1934 they represent imports for consumption only.
[4] Revised figures.
[5] Data not available.

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TABLE 2.—*Statistical trends of the coke industry, 1923 and 1935–38*—Continued

| | 1923 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Yield of byproducts per ton of coal charged: | | | | | |
| Tar.....gallons.. | 8.1 | 9.18 | 8.86 | 8.67 | (3) |
| Ammonium sulfate or equivalent pounds.. | 21.2 | 22.59 | 22.14 | 21.84 | 23.33 |
| Light oil.....gallons.. | 2.7 | 2.98 | 2.91 | 2.86 | (3) |
| Surplus gas sold or used..M cubic feet.. | 5.9 | 7.04 | [4] 6.85 | 6.66 | (3) |
| Average gross receipts of byproducts per ton of coke produced: | | | | | |
| Tar sold and used..... | $0.51 | $0.528 | $0.541 | $0.588 | (3) |
| Ammonia and its compounds..... | $0.84 | $0.310 | $0.287 | $0.326 | (3) |
| Light oil and its derivatives..... | $0.51 | $0.435 | [4] $0.438 | $0.435 | (3) |
| Surplus gas sold or used..... | $1.37 | $1.832 | $1.589 | $1.483 | (3) |
| Total byproducts, including breeze..... | $3.48 | $3.317 | [4] $3.057 | $3.060 | (3) |

[1] Subject to revision. [4] Revised figures. [3] Data not available.

## SCOPE OF REPORT

Owing to reduction in the funds appropriated for collection by the Bureau of Mines of statistical and economic data relating to the fuel industries it has been impossible to complete the 1938 annual canvass of the byproduct coke industry in time to publish the final data in the present Minerals Yearbook. In the majority of instances the preliminary data presented were furnished currently by the coke operators and will vary within a fraction of 1 percent from the final detailed statistics. The statistics pertaining to the beehive coke industry in this issue are complete and final. Final detailed statistics of both branches of the industry will be distributed in mimeographed form as soon as available and will be incorporated with 1939 data in the next volume of the Yearbook. If not readily found any derivative figures carried in earlier reports will be furnished by the Bureau upon application.

In the United States coke is produced by a group of four different industries. In addition to that manufactured in the familiar beehive and byproduct ovens coke is obtained in the refining of petroleum, in the manufacture of coal gas, and in the refining of tar. Within the last few years, also, production of a smokeless fuel by low-temperature carbonization of coal has been established commercially in the United States. The coke produced by each of these processes, however, varies greatly in character, and the problems affecting each of the industries are separate and distinct.

In 1938 about 1,602,200 tons of petroleum coke were produced compared with an output of 1,306,600 tons in 1937; approximately 918,400 tons of gas-house coke were made, a slight decrease from the 1937 output of 941,000 tons. The manufacture of coke from coal-tar pitch has been established on a commercial basis, but the tonnage produced is relatively small; in fact, the production in 1937—the latest year for which figures are available—amounted to only 181,495 tons, as reported by the United States Tariff Commission. None of these other kinds of coke are discussed in this report. Only coke from byproduct and beehive ovens is adapted to blast-furnace and foundry uses, which consume the bulk of all the coke produced. Practically, therefore, the coke trade is concerned only with byproduct and beehive coke, and the statistics of this report are confined to these two types.

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For reasons explained in a later section the statistics of byproduct coke in this chapter cover the operations of all byproduct coke ovens, including those installed and operated by public utilities engaged primarily in manufacturing gas for city supply.

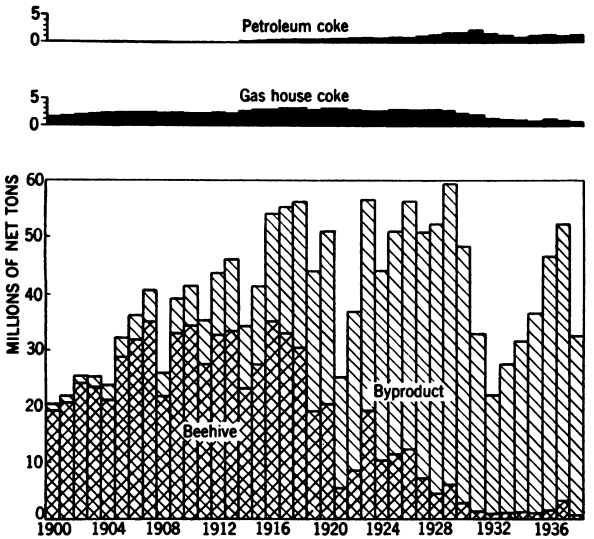


FIGURE 2.—Production of petroleum coke, gas-house coke, and beehive and byproduct coke in the United States, 1900–38. No figures on production of petroleum coke are available before 1914, when the production was 213,777 tons.

The standard unit of measurement in the coke industry is the short or net ton of 2,000 pounds, and unless otherwise specified that unit is employed throughout this report.

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# COKE AND COKE BREEZE

## MONTHLY AND WEEKLY PRODUCTION

TABLE 3.—*Byproduct, beehive, and total coke produced in the United States, 1935–38, by months, and average per day, in net tons*

| Month | 1935 | | 1936 | | 1937 | | 1938 [1] | |
|---|---|---|---|---|---|---|---|---|
| | Total | Daily average | Total | Daily average | Total | Daily average | Total | Daily average |
| Byproduct: | | | | | | | | |
| January | 2,796,800 | 90,200 | 3,313,500 | 106,900 | 4,360,700 | 140,700 | 2,762,500 | 89,100 |
| February | 2,777,200 | 99,200 | 3,145,600 | 108,500 | 3,992,900 | 142,600 | 2,493,600 | 89,100 |
| March | 2,907,100 | 93,800 | 3,262,100 | 105,200 | 4,495,500 | 145,000 | 2,675,100 | 86,300 |
| April | 2,666,200 | 88,800 | 3,471,400 | 115,700 | 4,350,900 | 145,000 | 2,436,300 | 81,200 |
| May | 2,789,200 | 90,000 | 3,758,800 | 121,300 | 4,479,700 | 144,500 | 2,282,600 | 73,600 |
| June | 2,595,000 | 86,500 | 3,700,300 | 123,300 | 4,024,800 | 134,200 | 2,066,500 | 68,900 |
| July | 2,562,000 | 82,600 | 3,723,200 | 120,100 | 4,423,900 | 142,700 | 2,176,600 | 70,200 |
| August | 2,773,600 | 89,400 | 3,871,400 | 124,900 | 4,573,400 | 147,500 | 2,494,500 | 80,500 |
| September | 2,832,700 | 94,400 | 3,836,800 | 127,900 | 4,427,800 | 147,600 | 2,675,100 | 89,200 |
| October | 3,048,300 | 98,300 | 4,077,200 | 131,500 | 4,035,100 | 130,200 | 3,092,800 | 99,800 |
| November | 3,112,100 | 103,700 | 4,054,400 | 135,100 | 3,222,300 | 107,400 | 3,277,500 | 109,300 |
| December | 3,363,900 | 108,500 | 4,354,400 | 140,500 | 2,823,800 | 91,100 | 3,362,800 | 108,500 |
| | 34,224,100 | 93,800 | 44,569,100 | 121,700 | 49,210,800 | 134,800 | 31,795,900 | 87,100 |
| Beehive: | | | | | | | | |
| January | 86,900 | 3,200 | 133,300 | 4,900 | 274,300 | 10,600 | 114,100 | 4,400 |
| February | 90,700 | 3,800 | 144,500 | 5,800 | 294,600 | 12,300 | 102,200 | 4,300 |
| March | 99,200 | 3,800 | 103,000 | 4,000 | 357,300 | 13,200 | 95,200 | 3,500 |
| April | 65,100 | 2,500 | 85,200 | 3,300 | 309,700 | 11,900 | 73,100 | 2,800 |
| May | 54,900 | 2,000 | 80,600 | 3,100 | 326,500 | 12,600 | 56,700 | 2,200 |
| June | 58,600 | 2,300 | 87,300 | 3,400 | 274,800 | 10,600 | 49,800 | 1,900 |
| July | 44,600 | 1,700 | 104,200 | 4,000 | 285,100 | 11,000 | 42,000 | 1,700 |
| August | 54,500 | 2,000 | 120,300 | 4,600 | 259,000 | 10,000 | 47,700 | 1,800 |
| September | 55,500 | 2,200 | 153,900 | 5,900 | 253,900 | 9,800 | 53,600 | 2,100 |
| October | 88,900 | 3,300 | 222,700 | 8,200 | 225,500 | 8,700 | 60,700 | 2,300 |
| November | 99,800 | 3,800 | 225,800 | 9,000 | 168,800 | 6,500 | 66,700 | 2,600 |
| December | 118,500 | 4,700 | 245,300 | 9,400 | 135,200 | 5,200 | 75,600 | 2,900 |
| | 917,200 | 2,900 | 1,706,100 | 5,500 | 3,164,700 | 10,200 | 837,400 | 2,700 |
| Total coke: | | | | | | | | |
| January | 2,883,700 | 93,400 | 3,446,800 | 111,800 | 4,635,000 | 151,300 | 2,876,600 | 93,500 |
| February | 2,867,900 | 103,000 | 3,290,100 | 114,300 | 4,287,500 | 154,900 | 2,595,800 | 93,400 |
| March | 3,006,300 | 97,600 | 3,365,100 | 109,200 | 4,852,800 | 158,200 | 2,770,300 | 89,800 |
| April | 2,731,300 | 91,300 | 3,556,600 | 119,000 | 4,660,600 | 156,900 | 2,509,400 | 84,000 |
| May | 2,844,100 | 92,000 | 3,839,400 | 124,400 | 4,806,200 | 157,100 | 2,339,300 | 75,800 |
| June | 2,653,600 | 88,800 | 3,787,600 | 126,700 | 4,299,600 | 144,800 | 2,116,300 | 70,800 |
| July | 2,606,600 | 84,300 | 3,827,400 | 124,100 | 4,709,000 | 153,700 | 2,218,600 | 71,900 |
| August | 2,828,100 | 91,400 | 3,991,700 | 129,500 | 4,832,400 | 157,500 | 2,542,200 | 82,300 |
| September | 2,888,200 | 96,600 | 3,990,700 | 133,800 | 4,681,700 | 157,400 | 2,728,700 | 91,300 |
| October | 3,137,200 | 101,600 | 4,299,900 | 139,700 | 4,260,600 | 138,900 | 3,153,500 | 102,100 |
| November | 3,211,900 | 107,500 | 4,280,200 | 144,100 | 3,391,100 | 113,900 | 3,344,200 | 111,900 |
| December | 3,482,400 | 113,200 | 4,599,700 | 149,900 | 2,959,000 | 96,300 | 3,438,400 | 111,400 |
| | 35,141,300 | 96,700 | 46,275,200 | 127,200 | 52,375,500 | 145,000 | 32,633,300 | 89,800 |

[1] Subject to revision.

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TABLE 4.—*Beehive coke produced in the United States, 1937–38, by weeks*

[Estimated from railroad shipments]

1937

| Week ended— | Net tons | Week ended— | Net tons | Week ended— | Net tons |
|---|---|---|---|---|---|
| Jan. 1–2 [1] | 19,900 | May 15 | 83,000 | Sept. 25 | 60,000 |
| Jan. 9 | 62,900 | May 22 | 74,600 | Oct. 2 | 56,700 |
| Jan. 16 | 62,400 | May 29 | 68,900 | Oct. 9 | 51,600 |
| Jan. 23 | 63,700 | June 5 | 62,300 | Oct. 16 | 57,200 |
| Jan. 30 | 63,800 | June 12 | 64,200 | Oct. 23 | 52,900 |
| Feb. 6 | 66,400 | June 19 | 61,500 | Oct. 30 | 47,000 |
| Feb. 13 | 69,900 | June 26 | 65,800 | Nov. 6 | 45,600 |
| Feb. 20 | 77,200 | July 3 | 63,500 | Nov. 13 | 41,400 |
| Feb. 27 | 79,500 | July 10 | 63,000 | Nov. 20 | 38,000 |
| Mar. 6 | 79,500 | July 17 | 64,000 | Nov. 27 | 33,800 |
| Mar. 13 | 82,900 | July 24 | 66,100 | Dec. 4 | 35,700 |
| Mar. 20 | 74,600 | July 31 | 61,000 | Dec. 11 | 31,200 |
| Mar. 27 | 89,100 | Aug. 7 | 58,200 | Dec. 18 | 32,100 |
| Apr. 3 | 59,300 | Aug. 14 | 61,300 | Dec. 25 | 27,900 |
| Apr. 10 | 63,600 | Aug. 21 | 62,300 | Dec. 27–31 [2] | 21,100 |
| Apr. 17 | 72,100 | Aug. 28 | 58,000 | | |
| Apr. 24 | 80,500 | Sept. 4 | 59,200 | | 3,164,700 |
| May 1 | 73,700 | Sept. 11 | 59,400 | | |
| May 8 | 76,600 | Sept. 18 | 58,600 | | |

1938

| | | | | | |
|---|---|---|---|---|---|
| Jan. 1 [3] | 4,000 | May 14 | 15,100 | Sept. 24 | 12,500 |
| Jan. 8 | 25,400 | May 21 | 12,100 | Oct. 1 | 13,800 |
| Jan. 15 | 26,100 | May 28 | 10,500 | Oct. 8 | 14,600 |
| Jan. 22 | 27,700 | June 4 | 11,400 | Oct. 15 | 14,700 |
| Jan. 29 | 25,800 | June 11 | 11,500 | Oct. 22 | 13,700 |
| Feb. 5 | 26,700 | June 18 | 13,400 | Oct. 29 | 13,400 |
| Feb. 12 | 26,300 | June 25 | 11,000 | Nov. 5 | 14,500 |
| Feb. 19 | 24,200 | July 2 | 9,900 | Nov. 12 | 13,300 |
| Feb. 26 | 24,600 | July 9 | 10,000 | Nov. 19 | 17,300 |
| Mar. 5 | 23,300 | July 16 | 10,200 | Nov. 26 | 16,000 |
| Mar. 12 | 20,700 | July 23 | 9,700 | Dec. 3 | 18,700 |
| Mar. 19 | 22,800 | July 30 | 9,100 | Dec. 10 | 17,800 |
| Mar. 26 | 19,400 | Aug. 6 | 11,300 | Dec. 17 | 16,000 |
| Apr. 2 | 17,500 | Aug. 13 | 10,400 | Dec. 24 | 16,000 |
| Apr. 9 | 15,500 | Aug. 20 | 10,700 | Dec. 31 | 17,000 |
| Apr. 16 | 17,800 | Aug. 27 | 10,800 | | |
| Apr. 23 | 16,400 | Sept. 3 | 10,400 | | 837,400 |
| Apr. 30 | 16,700 | Sept. 10 | 11,400 | | |
| May 7 | 15,000 | Sept. 17 | 13,300 | | |

[1] 2 days only. [2] 5 days only. [3] 1 day only.

TABLE 5.—*Byproduct coke produced in the United States in 1937, by months and States, in net tons* [1]

[Based on reports from all producers]

| State | January | February | March | April | May | June | July |
|---|---|---|---|---|---|---|---|
| Alabama | 332,400 | 312,800 | 367,500 | 338,600 | 361,000 | 354,000 | 368,700 |
| Colorado | 42,300 | 34,900 | 38,200 | 43,000 | 55,500 | 53,700 | 49,200 |
| Illinois | 243,000 | 232,500 | 267,800 | 259,400 | 260,000 | 237,700 | 263,200 |
| Indiana | 532,300 | 502,200 | 566,600 | 507,600 | 519,500 | 439,700 | 504,000 |
| Maryland | 127,700 | 132,000 | 140,200 | 138,000 | 135,700 | 134,900 | 137,900 |
| Massachusetts | 101,600 | 85,500 | 97,300 | 94,700 | 98,000 | 91,000 | 88,600 |
| Michigan | 187,300 | 169,000 | 202,900 | 130,500 | 163,300 | 205,400 | 207,800 |
| Minnesota | 72,600 | 64,400 | 66,700 | 62,800 | 64,700 | 56,800 | 54,200 |
| New Jersey | 85,400 | 76,600 | 86,300 | 84,400 | 88,200 | 83,900 | 85,500 |
| New York | 420,100 | 385,500 | 428,900 | 419,000 | 438,200 | 418,900 | 423,000 |
| Ohio | 576,800 | 531,100 | 640,200 | 648,200 | 640,100 | 376,300 | 613,600 |
| Pennsylvania | 1,314,400 | 1,189,400 | 1,256,200 | 1,290,700 | 1,311,400 | 1,237,900 | 1,277,300 |
| Tennessee | 7,100 | 7,600 | 8,800 | 8,700 | 8,600 | 6,800 | 6,900 |
| Utah | 13,000 | 11,700 | 12,500 | 12,100 | 12,200 | 14,800 | 16,700 |
| Washington | 2,300 | 1,900 | 1,900 | 2,000 | 1,700 | 1,500 | 1,400 |
| West Virginia | 149,400 | 140,000 | 161,400 | 153,000 | 158,200 | 151,600 | 158,000 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 153,000 | 115,800 | 152,100 | 158,200 | 163,400 | 159,900 | 167,900 |
| Total production | 4,360,700 | 3,992,900 | 4,495,500 | 4,350,900 | 4,479,700 | 4,024,800 | 4,423,900 |
| At merchant plants | 1,119,100 | 996,400 | 1,140,500 | 1,040,600 | 1,104,100 | 1,107,300 | 1,107,800 |
| At furnace plants | 3,241,600 | 2,996,500 | 3,355,000 | 3,310,300 | 3,375,600 | 2,917,500 | 3,316,100 |

[1] Figures for 1938 not yet available.



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TABLE 5—*Byproduct coke produced in the United States in 1937, by months and States, in net tons*—Continued.

| State | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|
| Alabama | 386,800 | 372,100 | 387,300 | 346,000 | 332,600 | 4,259,800 |
| Colorado | 46,800 | 43,500 | 29,300 | 33,000 | 17,600 | 487,000 |
| Illinois | 286,000 | 270,600 | 245,600 | 219,200 | 213,800 | 2,998,800 |
| Indiana | 512,700 | 504,800 | 395,000 | 264,900 | 217,700 | 5,467,000 |
| Maryland | 135,800 | 131,500 | 118,200 | 95,600 | 86,200 | 1,513,700 |
| Massachusetts | 88,200 | 91,800 | 99,600 | 94,700 | 99,600 | 1,130,600 |
| Michigan | 208,400 | 203,500 | 212,400 | 207,800 | 185,200 | 2,283,500 |
| Minnesota | 54,800 | 55,300 | 54,900 | 48,600 | 48,800 | 704,600 |
| New Jersey | 86,400 | 83,600 | 85,200 | 83,200 | 86,300 | 1,015,000 |
| New York | 426,300 | 417,700 | 441,200 | 377,900 | 350,300 | 4,947,000 |
| Ohio | 690,600 | 657,800 | 608,600 | 424,800 | 329,800 | 6,737,900 |
| Pennsylvania | 1,297,400 | 1,248,900 | 1,009,800 | 709,500 | 558,300 | 13,701,200 |
| Tennessee | 6,900 | 6,900 | 7,100 | 6,900 | 7,100 | 89,400 |
| Utah | 14,900 | 14,000 | 6,200 | 6,400 | 15,200 | 149,700 |
| Washington | 1,300 | 700 | | | | 14,700 |
| West Virginia | 162,600 | 159,900 | 165,800 | 141,000 | 117,100 | 1,818,000 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 167,500 | 165,200 | 168,900 | 162,800 | 158,200 | 1,892,900 |
| Total production | 4,573,400 | 4,427,800 | 4,035,100 | 3,222,300 | 2,823,800 | 49,210,800 |
| At merchant plants | 1,104,100 | 1,093,100 | 1,124,600 | 1,079,600 | 1,059,400 | 13,076,600 |
| At furnace plants | 3,469,300 | 3,334,700 | 2,910,500 | 2,142,700 | 1,764,400 | 36,134,200 |

TABLE 6.—*Beehive coke produced in the United States, 1937–38, by months and States, in net tons*

[Based on railroad shipments]

| State | January | February | March | April | May | June | July |
|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | |
| Colorado | 6,600 | 4,300 | 6,500 | 4,600 | 5,600 | 4,900 | 4,000 |
| Pennsylvania | 230,300 | 247,600 | 293,800 | 271,200 | 268,700 | 226,200 | 231,000 |
| Tennessee | 600 | 1,100 | 2,100 | 1,100 | 1,600 | 1,300 | 1,400 |
| Utah | 100 | 100 | 200 | 200 | 300 | 600 | 900 |
| Virginia | 16,100 | 18,400 | 26,100 | 7,300 | 25,200 | 25,400 | 23,400 |
| West Virginia | 20,600 | 23,100 | 28,600 | 25,300 | 25,100 | 16,400 | 24,400 |
| | 274,300 | 294,600 | 357,300 | 309,700 | 326,500 | 274,800 | 285,100 |
| 1938 | | | | | | | |
| Colorado | 4,900 | 4,200 | 5,200 | 4,500 | 4,700 | 4,000 | 3,200 |
| Pennsylvania | 78,400 | 68,700 | 63,000 | 46,000 | 29,700 | 21,900 | 18,000 |
| Tennessee | 500 | 700 | 400 | 300 | 200 | 200 | 400 |
| Utah | 1,400 | 900 | 500 | 400 | 400 | 500 | 300 |
| Virginia | 11,200 | 9,200 | 9,000 | 7,500 | 5,100 | 8,700 | 11,400 |
| West Virginia | 17,700 | 18,500 | 17,100 | 14,400 | 16,600 | 14,500 | 8,700 |
| | 114,100 | 102,200 | 95,200 | 73,100 | 56,700 | 49,800 | 42,000 |

| State | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|
| 1937 | | | | | | |
| Colorado | 3,600 | 4,600 | 6,600 | 7,200 | 5,700 | 64,200 |
| Pennsylvania | 211,400 | 203,000 | 166,300 | 119,700 | 89,800 | 2,559,000 |
| Tennessee | 1,500 | 1,400 | 1,700 | 700 | 500 | 15,000 |
| Utah | 800 | 600 | 1,000 | 900 | 1,000 | 6,700 |
| Virginia | 18,800 | 19,400 | 24,200 | 18,500 | 17,600 | 240,400 |
| West Virginia | 22,900 | 24,900 | 25,700 | 21,800 | 20,600 | 279,400 |
| | 259,000 | 253,900 | 225,500 | 168,800 | 135,200 | 3,164,700 |
| 1938 | | | | | | |
| Colorado | 2,700 | 2,200 | 3,000 | 7,400 | 8,700 | 54,700 |
| Pennsylvania | 18,000 | 25,200 | 32,100 | 36,800 | 44,300 | 482,100 |
| Tennessee | 700 | 600 | 700 | 500 | 300 | 5,500 |
| Utah | 600 | 600 | 900 | 800 | 400 | 7,700 |
| Virginia | 14,200 | 13,300 | 13,500 | 14,100 | 16,700 | 133,900 |
| West Virginia | 11,500 | 11,700 | 10,500 | 7,100 | 5,200 | 153,500 |
| | 47,700 | 53,600 | 60,700 | 66,700 | 75,600 | 837,400 |

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## PRODUCTION BY FURNACE AND NONFURNACE PLANTS

The terms "furnace" and "merchant" operators originated in the Connellsville beehive coke trade. As the name implies the beehive-furnace interests are those affiliated with the producers of iron and steel whose output does not ordinarily enter the open market. There are, however, a number of byproduct plants financially affiliated with iron furnaces, in which the bulk of the product is nevertheless foundry and domestic coke that must be sold on the competitive market. Inasmuch as the beehive coke trade has dwindled during the past decade to a position of little significance in the coke industry (in 1938 supplying only 2.6 percent of the total production) the statistics presented in the two following tables cover byproduct coke only.

A "furnace" plant is herein defined as one that has for its main business the production of furnace coke and that has an assured outlet for such coke either through financial affiliation with or direct ownership by an ironworks, or through long-time contracts. Under this definition the class designated as "other" plants includes a few plants affiliated with local iron furnaces but producing much more coke than the furnaces can absorb and therefore depending chiefly on the foundry and domestic trade or on merchant sales of furnace coke. It also includes merchant producers of furnace coke who have to sell their output on the competitive market; the plants affiliated with alkali works; and, in addition, a number of plants that, although not public utilities, were constructed primarily to supply city gas and that must sell their coke where they can for domestic and industrial as well as metallurgical use.

In 1938, 43 furnace plants produced 20,679,091 tons of byproduct coke and 40 "other" plants produced 11,116,801 tons. The relative proportion furnished by furnace plants has remained fairly constant except in the years of iron and steel depression. Thus, in 1913 and again in 1918, furnace plants produced approximately 73 percent of the total byproduct coke output. In 1932, a year of great steel depression, the proportion fell to 54 percent; it rose to 73 percent in 1937 and fell again to 65 percent in 1938.

TABLE 7.—*Number and production of byproduct coke plants connected with iron furnaces and of other byproduct plants, 1913, 1918, and 1936–38*

| Year | Number of active plants | | Coke produced (net tons) | | Percent of production | |
|---|---|---|---|---|---|---|
| | Furnace plants | Other plants | Furnace plants | Other plants | Furnace plants | Other plants |
| 1913 | 20 | 16 | 9,277,832 | 3,436,868 | 73.0 | 27.0 |
| 1918 | 36 | 24 | 19,220,342 | 6,777,238 | 73.9 | 26.1 |
| 1936 | 42 | 43 | 32,076,089 | 12,493,032 | 72.0 | 28.0 |
| 1937 | 43 | 42 | 36,134,209 | 13,076,539 | 73.4 | 26.6 |
| 1938 [1] | 43 | 40 | 20,679,091 | 11,116,801 | 65.0 | 35.0 |

[1] Subject to revision.

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TABLE 8.—*Monthly and average daily production of byproduct coke by plants associated with iron furnaces and by all other plants, 1936–38, in net tons*

| Month | 1936 | | 1937 | | 1938[1] | |
|---|---|---|---|---|---|---|
| | Furnace plants | Other plants | Furnace plants | Other plants | Furnace plants | Other plants |
| Monthly production: | | | | | | |
| January | 2,294,400 | 1,019,100 | 3,241,600 | 1,119,100 | 1,711,700 | 1,050,800 |
| February | 2,173,300 | 972,300 | 2,996,500 | 996,400 | 1,544,800 | 948,800 |
| March | 2,250,700 | 1,011,400 | 3,355,000 | 1,140,500 | 1,673,100 | 1,002,000 |
| April | 2,483,200 | 988,200 | 3,310,300 | 1,040,600 | 1,494,600 | 941,700 |
| May | 2,724,600 | 1,034,200 | 3,375,600 | 1,104,100 | 1,375,400 | 907,200 |
| June | 2,697,300 | 1,003,000 | 2,917,500 | 1,107,300 | 1,225,000 | 841,500 |
| July | 2,703,000 | 1,020,200 | 3,316,100 | 1,107,800 | 1,351,300 | 825,300 |
| August | 2,827,100 | 1,044,300 | 3,469,300 | 1,104,100 | 1,646,600 | 847,900 |
| September | 2,795,300 | 1,041,500 | 3,334,700 | 1,093,100 | 1,798,800 | 876,300 |
| October | 2,976,100 | 1,101,100 | 2,910,500 | 1,124,600 | 2,139,000 | 953,800 |
| November | 2,958,900 | 1,095,500 | 2,142,700 | 1,079,600 | 2,339,400 | 938,100 |
| December | 3,192,200 | 1,162,200 | 1,764,400 | 1,059,400 | 2,379,400 | 983,400 |
| | 32,076,100 | 12,493,000 | 36,134,200 | 13,076,600 | 20,679,100 | 11,116,800 |
| Average daily production: | | | | | | |
| January | 74,000 | 32,900 | 104,600 | 36,100 | 55,200 | 33,900 |
| February | 75,000 | 33,500 | 107,000 | 35,600 | 55,200 | 33,900 |
| March | 72,600 | 32,600 | 108,200 | 36,800 | 54,000 | 32,300 |
| April | 82,800 | 32,900 | 110,300 | 34,700 | 49,800 | 31,400 |
| May | 87,900 | 33,400 | 108,900 | 35,600 | 44,400 | 29,200 |
| June | 89,900 | 33,400 | 97,300 | 36,900 | 40,800 | 28,100 |
| July | 87,200 | 32,900 | 107,000 | 35,700 | 43,600 | 26,600 |
| August | 91,200 | 33,700 | 111,900 | 35,600 | 53,100 | 27,400 |
| September | 93,200 | 34,700 | 111,200 | 36,400 | 60,000 | 29,200 |
| October | 96,000 | 35,500 | 93,900 | 36,300 | 69,000 | 30,800 |
| November | 98,600 | 36,500 | 71,400 | 36,000 | 78,000 | 31,300 |
| December | 103,000 | 37,500 | 56,900 | 34,200 | 76,800 | 31,700 |
| Average | 87,600 | 34,100 | 99,000 | 35,800 | 56,700 | 30,400 |

[1] Subject to revision.

## PRODUCTION BY STATES AND DISTRICTS

All 21 States that produced byproduct coke in 1938 shared the decreased output, the percentage of decrease being higher in those States dominated by furnace interests. Thus, Colorado showed the highest relative decrease—61 percent—followed by Pennsylvania with a decline of 48 percent, Indiana with 47 percent, Ohio with 45 percent, and Illinois with 42 percent. Other rates of decrease ranged from 0.2 percent in Massachusetts (a "merchant" State) to 27 percent in Maryland.

In rank of producing importance the position of Pennsylvania remains unchallenged. In 1938 the State contributed 22 percent of the byproduct coke total, 58 percent of the beehive, and 23 percent of all coke produced in the United States. Not only is Pennsylvania the principal coke-producing State, but large quantities of her celebrated coking coals are shipped annually to other States for use in byproduct ovens. The famous Pittsburgh bed, underlying the Pittsburgh, Connellsville, and adjacent fields, is probably the largest repository of high-grade coking coal in the world.

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TABLE 9.—*Summary of coke produced, value, number of ovens, coal charged, and average yield in 1937, by States* [1]

[Exclusive of screenings or breeze]

| State | Byproduct | | | | | | |
|---|---|---|---|---|---|---|---|
| | Plants in existance | Ovens in existance | Coal used (net tons) | Yield of coke from coal (percent) | Coke produced (net tons) | Value of coke at ovens | |
| | | | | | | Total | Per ton |
| Alabama | 8 | 1,254 | 5,886,198 | 72.37 | 4,259,771 | $13,275,098 | $3.12 |
| Colorado | 1 | 149 | 722,865 | 67.36 | 486,945 | (2) | (2) |
| Connecticut | 1 | 61 | (2) | (2) | (2) | (2) | (2) |
| Illinois | 8 | 896 | 4,251,016 | 70.54 | 2,998,663 | 20,213,129 | 6.74 |
| Indiana | 6 | 1,607 | 7,588,989 | 72.04 | 5,467,061 | 32,655,355 | 5.97 |
| Kentucky | 1 | 108 | (2) | (2) | (2) | (2) | (2) |
| Maryland | 1 | 361 | 2,084,471 | 72.62 | 1,513,651 | (2) | (2) |
| Massachusetts | 2 | 215 | 1,615,444 | 69.99 | 1,130,620 | (2) | (2) |
| Michigan | 9 | 676 | 3,213,934 | 71.05 | 2,283,518 | 13,816,401 | 6.05 |
| Minnesota | 3 | 196 | 1,002,812 | 70.27 | 704,631 | 5,611,287 | 7.96 |
| Missouri | 1 | 64 | (2) | (2) | (2) | (2) | (2) |
| New Jersey | 2 | 239 | 1,434,022 | 70.78 | 1,015,073 | (2) | (2) |
| New York | 8 | 978 | 6,894,332 | 71.75 | 4,946,964 | 29,853,516 | 6.03 |
| Ohio | 15 | 1,839 | 9,409,187 | 71.61 | 6,737,881 | 32,185,945 | 4.78 |
| Pennsylvania | 12 | 3,348 | 19,907,104 | 68.83 | 13,701,262 | 55,142,252 | 4.02 |
| Rhode Island | 1 | 65 | (2) | (2) | (2) | (2) | (2) |
| Tennessee | 1 | 24 | 129,635 | 69.00 | 89,451 | 432,943 | 4.84 |
| Utah | 1 | 56 | 264,070 | 56.67 | 149,659 | (2) | (2) |
| Virginia | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| Washington | ------ | (4) | 26,118 | 56.11 | 14,656 | 87,936 | 6.00 |
| West Virginia | 4 | 387 | 2,572,329 | 70.67 | 1,817,993 | 5,822,004 | 3.20 |
| Wisconsin | 2 | 195 | (2) | (2) | (2) | (2) | (2) |
| Combined States | ------ | ------ | 2,572,847 | 73.57 | 1,892,949 | 13,628,440 | 7.20 |
| Undistributed | ------ | ------ | ------ | ------ | ------ | 24,631,446 | 5.73 |
| Grand total: 1937 | 87 | 12,718 | 69,575,373 | 70.73 | 49,210,748 | 247,355,752 | 5.03 |
| 1936 | 90 | 12,849 | 63,243,517 | 70.47 | 44,569,121 | 225,695,719 | 5.06 |
| Change in 1937, percent | −3.3 | −1.0 | +10.0 | +0.4 | +10.4 | +9.6 | −0.6 |

See footnotes at end of table.

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TABLE 9.—*Summary of coke produced, value, number of ovens, coal charged, and average yield in 1937, by States*—Continued

| State | Beehive | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Ovens in existance | Coal used (net tons) | Yield of coke from coal (percent) | Coke produced (net tons) | Value of coke at ovens | | Coke produced (net tons) | Value of coke at ovens |
| | | | | | Total | Per ton | | |
| Alabama | | | | | | | 4,259,771 | $13,275,098 |
| Colorado | 188 | 115,278 | 55.71 | 64,222 | (2) | (2) | 551,167 | (2) |
| Connecticut | | | | | | | (3) | (3) |
| Illinois | | | | | | | 2,998,663 | 20,213,129 |
| Indiana | | | | | | | 5,467,061 | 32,655,355 |
| Kentucky | | | | | | | (3) | (3) |
| Maryland | | | | | | | 1,513,651 | (2) |
| Massachusetts | | | | | | | 1,130,620 | (2) |
| Michigan | | | | | | | 2,283,518 | 13,816,401 |
| Minnesota | | | | | | | 704,631 | 5,611,287 |
| Missouri | | | | | | | (3) | (3) |
| New Jersey | | | | | | | 1,015,073 | (2) |
| New York | | | | | | | 4,946,964 | 29,853,516 |
| Ohio | | | | | | | 6,737,881 | 32,185,945 |
| Pennsylvania | 8,239 | 3,906,754 | 65.50 | 2,559,048 | $10,699,200 | $4.18 | 16,260,310 | 65,841,452 |
| Rhode Island | | | | | | | (3) | (3) |
| Tennessee | 140 | 27,803 | 53.89 | 14,982 | 86,134 | 5.75 | 104,433 | 519,077 |
| Utah | 819 | 12,271 | 54.25 | 6,657 | (2) | (2) | 156,316 | (2) |
| Virginia | 1,291 | 412,192 | 58.33 | 240,425 | 1,180,800 | 4.91 | 240,425 | 1,180,800 |
| Washington | 58 | | | | | | 14,656 | 87,936 |
| West Virginia | 1,459 | 452,526 | 61.74 | 279,387 | 1,232,182 | 4.41 | 2,097,380 | 7,054,186 |
| Wisconsin | | | | | | | (3) | (3) |
| Combined States | | | | | | | 1,892,949 | 13,628,440 |
| Undistributed | | | | | 449,835 | 6.35 | | 25,081,281 |
| Grand total: | | | | | | | | |
| 1937 | 12,194 | 4,926,824 | 64.23 | 3,164,721 | 13,648,151 | 4.31 | 52,375,469 | 261,003,903 |
| 1936 | 13,012 | 2,698,158 | 63.23 | 1,706,063 | 6,678,272 | 3.91 | 46,275,184 | 232,373,991 |
| Change in 1937, percent | −6.3 | +82.6 | +1.6 | +85.5 | +104.4 | +10.2 | +13.2 | +12.3 |

[1] Figures for 1938 not yet available.
[2] Included under "Undistributed."
[3] Included under "Combined States."
[4] 20 ovens operated from January to November, after which plant was abandoned.

TABLE 10.—*Byproduct and beehive coke produced, by States, 1918 and 1935–38, in net tons*

| State | 1918 | 1935 | 1936 | 1937 | 1938[1] |
|---|---|---|---|---|---|
| Byproduct: | | | | | |
| Alabama | 2,634,451 | 1,994,220 | 3,089,622 | 4,259,771 | 3,374,898 |
| Colorado | 230,663 | 206,901 | 337,341 | 486,945 | 191,839 |
| Connecticut | | (2) | (2) | (2) | (2) |
| Illinois | 2,285,610 | 1,668,523 | 2,082,516 | 2,998,663 | 1,738,106 |
| Indiana | 3,898,215 | 3,768,480 | 5,449,755 | 5,467,061 | 2,894,548 |
| Kentucky | 517,749 | (2) | (2) | (2) | (2) |
| Maryland | 474,368 | 929,617 | 1,217,039 | 1,513,651 | 1,105,262 |
| Massachusetts | 556,397 | 1,006,115 | 1,108,219 | 1,130,620 | 1,128,612 |
| Michigan | (2) | 2,482,302 | 2,293,653 | 2,283,518 | 1,751,781 |
| Minnesota | 784,065 | 430,082 | 521,518 | 704,631 | 540,447 |
| Missouri | (2) | (2) | (2) | (2) | (2) |
| New Jersey | 682,148 | 917,117 | 1,007,500 | 1,015,073 | 1,002,305 |
| New York | 1,069,587 | 4,099,242 | 4,835,921 | 4,946,964 | 3,948,833 |
| Ohio | 5,226,334 | 5,100,987 | 6,242,300 | 6,737,881 | 3,703,819 |
| Pennsylvania | 4,586,981 | 8,078,175 | 12,570,816 | 13,701,262 | 7,124,694 |
| Rhode Island | | (2) | (2) | (2) | (2) |
| Tennessee | 124,469 | 78,668 | 83,305 | 89,451 | 75,906 |
| Utah | | 115,282 | 124,346 | 149,659 | 133,927 |
| Washington | 30,129 | 28,744 | 28,368 | 14,656 | |
| West Virginia | 603,393 | 1,603,584 | 1,702,792 | 1,817,993 | 1,360,375 |
| Wisconsin | (2) | (2) | (2) | (2) | (2) |
| Combined States | 2,293,021 | 1,716,014 | 1,874,110 | 1,892,949 | 1,720,540 |
| | 25,997,580 | 34,224,053 | 44,569,121 | 49,210,748 | 31,795,892 |

See footnotes at end of table.

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TABLE 10.—*Byproduct and beehive coke produced, by States, 1918 and 1935–38, in net tons*—Continued

| State | 1918 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Beehive: | | | | | |
| Alabama | 1,717,721 | | | | |
| Colorado | 758,784 | 49,209 | 61,293 | 64,222 | 54,721 |
| Georgia | 22,048 | | | | |
| Kentucky | 301,036 | | | | |
| New Mexico | 597,072 | | | | |
| Ohio | 138,909 | | | | |
| Oklahoma | [2] | | | | |
| Pennsylvania | 22,136,664 | 564,052 | 1,213,294 | 2,559,048 | 482,105 |
| Tennessee | 302,637 | 3,099 | 3,567 | 14,982 | 5,500 |
| Utah | [2] | 5,575 | 5,617 | 6,657 | 7,668 |
| Virginia | 1,234,256 | 137,587 | 191,331 | 240,425 | 133,905 |
| Washington | 93,659 | 2,475 | 312 | | |
| West Virginia | 2,716,613 | 155,211 | 230,649 | 279,387 | 153,513 |
| Combined States | 461,393 | | | | |
| | 30,480,792 | 917,208 | 1,706,063 | 3,164,721 | 837,412 |
| Grand total | 56,478,372 | 35,141,261 | 46,275,184 | 52,375,469 | 32,633,304 |

[1] Figures for byproduct subject to revision.
[2] Included under "Combined States."

TABLE 11.—*Byproduct and beehive coke produced in Pennsylvania in 1937, by districts* [1]

[Number of plants and ovens includes those idle during the year; no new ovens were under construction in 1937]

| District | Plants | Ovens | Coal used (net tons) | Yield of coke from coal (percent) | Coke produced (net tons) | Value of coke at ovens | |
|---|---|---|---|---|---|---|---|
| | | | | | | Total | Per ton |
| Byproduct: | | | | | | | |
| Eastern Pennsylvania [2] | 5 | 734 | 3,265,323 | 69.73 | 2,277,035 | $14,065,111 | $6.18 |
| Western Pennsylvania [3] | 7 | 2,614 | 16,641,781 | 68.65 | 11,424,227 | 41,077,141 | 3.60 |
| | 12 | 3,348 | 19,907,104 | 68.83 | 13,701,262 | 55,142,252 | 4.02 |
| Beehive: | | | | | | | |
| Allegheny Mountain and Allegheny Valley | 2 | 242 | 64,103 | 57.04 | 36,567 | 183,497 | 5.02 |
| Connellsville | 20 | 2,983 | 1,355,627 | 66.15 | 896,749 | 3,593,349 | 4.01 |
| Lower Connellsville | 18 | 3,001 | 1,659,105 | 66.09 | 1,096,426 | 4,427,136 | 4.04 |
| Upper Connellsville | 5 | 728 | 215,112 | 66.89 | 143,896 | 656,485 | 4.56 |
| Pittsburgh and other districts [4] | 6 | 1,285 | 612,807 | 62.89 | 385,410 | 1,838,733 | 4.77 |
| | 51 | 8,239 | 3,906,754 | 65.50 | 2,559,048 | 10,699,200 | 4.18 |
| Grand total | 63 | 11,587 | 23,813,858 | 68.28 | 16,260,310 | 65,841,452 | 4.05 |

[1] Figures for 1938 not yet available.
[2] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[3] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Neville Island, and Pittsburgh.
[4] Includes Bedford and parts of Indiana and Westmoreland Counties.

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TABLE 12.—*Byproduct coke produced in Ohio in 1937, by districts* [1]

| District | Plants | Ovens [2] | Coal used (net tons) | Yield of coke from coal (percent) | Coke produced (net tons) | Value of coke at ovens | |
|---|---|---|---|---|---|---|---|
| | | | | | | Total | Per ton |
| Canton, Cleveland, and Massillon | 5 | 595 | 2,790,415 | 72.29 | 2,017,183 | $9,735,347 | $4.83 |
| Youngstown | 3 | 594 | 2,460,762 | 69.10 | 1,700,441 | 7,757,765 | 4.56 |
| Other districts [3] | 7 | 650 | 4,158,010 | 72.64 | 3,020,257 | 14,692,833 | 4.86 |
| Total: 1937 | 15 | 1,839 | 9,409,187 | 71.61 | 6,737,881 | 32,185,945 | 4.78 |
| 1936 | 15 | 1,839 | 8,760,708 | 71.25 | 6,242,300 | 26,938,007 | 4.32 |
| Change in 1937, percent | | | +7.4 | +0.5 | +7.9 | +19.5 | +10.6 |

[1] Figures for 1938 not yet available.
[2] In addition 15 ovens were under construction at the close of 1937.
[3] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

## NUMBER AND TYPE OF OVENS

In the byproduct branch of the coke industry 202 new byproduct ovens were completed and put into operation during 1938; of these 41 were in Colorado, 12 in Kentucky, 65 in Michigan, and 84 in Ohio. One new furnace plant was added to the active list, operations beginning in October 1938. At the close of the year 126 ovens still were under construction, and 182 had been abandoned, the total in existence at the 88 plants being about 12,650. Four of the 88 plants were idle throughout the year, 7 were out of blast at the close of December, and a few others operated on a part-time basis.

Beehive coke ovens have been dismantled steadily during the past 3 decades and in 1937 were exceeded in number by byproduct ovens for the first time. In 1910 there were 100,362 beehive ovens; in 1920, 75,298; and in 1930, 23,907; in 1938, only 10,816 remained. Byproduct ovens during the same period rose from 4,078 in 1910 to 10,881 in 1920, and to 12,831 in 1930, but dropped to 12,650 in 1938, the net change during the past 8 years being slight. There is of course no basis of comparison between a byproduct and a beehive oven with respect to operating capacity, but the figures show the changing trend of coking practices.

The 72 beehive coke plants in existence at the close of 1938 comprised 10,816 ovens. However, only 38 plants with a total of 5,453 ovens were active. In 1938, for the first time, the Bureau of Mines asked beehive operators to report the average number of ovens active during each month of 1938. Responses to this inquiry indicate that the highest number operating in any month (January) was 2,729 ovens and the lowest (October) was 1,519—an unweighted average for the year of 1,846 ovens.

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TABLE 13.—*Coke ovens completed and abandoned in 1937 and total number in existence at end of year, by States* [1]

| State | Plants in existence Dec. 31 | Ovens | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | In existence Dec. 31 | | New | | Abandoned during year | Under construction Dec. 31 | |
| | | Number | Capacity per day (net tons of coke) | Number | Capacity per day (net tons of coke) | | Number | Capacity per day (net tons of coke) |
| Byproduct: | | | | | | | | |
| Alabama | 8 | 1,254 | 14,766 | [2] 184 | [2] 2,621 | 140 | | |
| Colorado | 1 | 149 | 2,233 | | | 2 | 41 | 710 |
| Connecticut | 1 | 61 | [3] | | | | | |
| Illinois | 8 | 896 | 12,382 | | | | | |
| Indiana | 6 | 1,607 | 22,118 | [4] 197 | [4] 2,359 | | | |
| Kentucky | 1 | 108 | [3] | | | | 12 | [3] |
| Maryland | 1 | 361 | 5,088 | | | | | |
| Massachusetts | 2 | 215 | 3,553 | | | 215 | | |
| Michigan | 9 | 676 | 7,472 | 122 | 2,030 | 60 | 191 | 3,565 |
| Minnesota | 3 | 196 | 2,572 | | | | | |
| Missouri | 1 | 64 | [3] | | | | | |
| New Jersey | 2 | 239 | 2,750 | | | | | |
| New York | 8 | 978 | 14,859 | | | 46 | | |
| Ohio | 15 | 1,839 | 24,957 | | | | 15 | [3] |
| Pennsylvania | 12 | 3,348 | 46,058 | | | | | |
| Rhode Island | 1 | 65 | [3] | | | | | |
| Tennessee | 1 | 24 | 350 | | | | | |
| Utah | 1 | 56 | 705 | | | | | |
| Washington | | | | | | [5] 20 | | |
| West Virginia | 4 | 387 | 5,511 | 25 | 420 | | | |
| Wisconsin | 2 | 195 | [3] | | | | | |
| Undistributed | | | 6,481 | | | | | 422 |
| Total byproduct | 87 | 12,718 | 171,855 | 528 | 7,430 | 483 | 259 | 4,697 |
| At merchant plants | 42 | 3,419 | 43,101 | 25 | 420 | 281 | 12 | 4,697 |
| At furnace plants | 45 | 9,299 | 128,754 | 503 | 7,010 | 202 | 247 | |
| Beehive: | | | | | | | | |
| Colorado | 2 | 188 | | | | | | |
| Pennsylvania | 51 | 8,239 | | [6] 994 | [7] | 749 | | |
| Tennessee | 2 | 140 | | [6] 15 | [7] | | | |
| Utah | 1 | 819 | | | | | | |
| Virginia | 7 | 1,291 | [7] | [6] 28 | [7] | | | |
| Washington | 1 | 58 | | | | | | |
| West Virginia | 9 | 1,459 | | [6] 88 | [7] | | | |
| Total beehive | 73 | 12,194 | | 1,125 | [7] | 749 | | |

[1] Figures for 1938 not yet available.
[2] Includes 38 new ovens, 421 tons capacity, replacing old ovens that were rebuilt.
[3] Included under "Undistributed."
[4] Includes 138 new ovens, 1,559 tons capacity, replacing old ovens that were rebuilt.
[5] Abandoned after producing.
[6] All old ovens rebuilt or repaired, some of which were reported abandoned in previous years.
[7] Data not available.

TABLE 14.—*Beehive ovens active in 1938, by months*

| Month | Number | Month | Number | Month | Number |
|---|---|---|---|---|---|
| January | 2,729 | May | 1,664 | September | 1,711 |
| February | 2,419 | June | 1,590 | October | 1,519 |
| March | 2,119 | July | 1,548 | November | 1,702 |
| April | 1,869 | August | 1,624 | December | 1,655 |

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TABLE 15.—*Byproduct ovens of each type at end of 1937, by States* [1]

| State | Koppers [2] | Semet-Solvay | Wilputte | Cambria | Roberts Morrissey | American Foundation | All others [3] | Tota |
|---|---|---|---|---|---|---|---|---|
| Alabama | 774 | 420 | 60 | | | | | 1,254 |
| Colorado | 149 | | | | | | | 149 |
| Connecticut | 61 | | | | | | | 61 |
| Illinois | 662 | 120 | 88 | | | | 26 | 896 |
| Indiana | 1,186 | 161 | 260 | | | | | 1,607 |
| Kentucky | | 108 | | | | | | 108 |
| Maryland | 361 | | | | | | | 361 |
| Massachusetts | 160 | | 55 | | | | | 215 |
| Michigan | 253 | 216 | 120 | | | | 87 | 676 |
| Minnesota | 196 | | | | | | | 196 |
| Missouri | 56 | | | | | | 8 | 64 |
| New Jersey | 239 | | | | | | | 239 |
| New York | 743 | 180 | | | | 55 | | 978 |
| Ohio | 1,546 | 293 | | | | | | 1,839 |
| Pennsylvania | 3,018 | 88 | 97 | 120 | 25 | | | 3,348 |
| Rhode Island | 65 | | | | | | | 65 |
| Tennessee | | 24 | | | | | | 24 |
| Utah | 56 | | | | | | | 56 |
| West Virginia | 316 | | 71 | | | | | 387 |
| Wisconsin | 115 | 80 | | | | | | 195 |
| Total | 9,956 | 1,690 | 751 | 120 | 25 | 55 | 121 | 12,718 |
| At merchant plants | 1,938 | 1,034 | 246 | | 25 | 55 | 121 | 3,419 |
| At furnace plants | 8,018 | 656 | 505 | 120 | | | | 9,299 |

[1] Figures for 1938 not yet available.
[2] Includes the Koppers-Becker type.
[3] Includes 26 Curran-Knowles, 27 Parker-Russell, 60 Improved Equipment Co., and 8 Piette ovens.

## CAPACITY OF BYPRODUCT OVENS

The reported maximum capacity of the byproduct ovens in existence is seldom if ever attained for various practical reasons that may be due to operating, economic, or labor conditions. It has been stated that the efficient life of a coke oven is limited to 20 years, as high radiation losses occur after that period; other claims have been made that ovens built 25 years ago still are capable of efficient operation. Had it not been for the depression years much replacement building would have been done. The closing down of ovens over an extended period added to their life and made replacement unnecessary in many instances.

The maximum daily capacity of the 88 byproduct coke plants in existence December 31, 1938, was 174,690 tons, an increase of about 1.6 percent compared with that reported for 87 plants at the end of 1937. The daily capacity at the 42 merchant plants was 43,290 tons, an average of 1,031 tons per plant, while at the 46 furnace plants the capacity was 131,400 tons (2,857 tons per plant), the furnace plants as a rule carrying larger batteries of ovens.

Production of byproduct coke in 1938 was 51 percent of the calculated capacity of all by product ovens compared with 79 percent in 1937 and 91 percent in the peak year 1929. Furnace plants operated at only 44 percent of capacity, while merchant plants operated at 71 percent.

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TABLE 16.—*Estimated annual potential production of coke and coal required for charge of byproduct coke ovens in the United States, 1936–37, when operated at different percentages of maximum capacity, in millions of net tons* [1]

| Percent of maximum capacity | 1936 | | | | 1937 | | | |
|---|---|---|---|---|---|---|---|---|
| | Ovens completed Dec. 31 | | Including ovens under construction | | Ovens completed Dec. 31 | | Including ovens under construction | |
| | Coke | Coal [2] | Coke | Coal [2] | Coke | Coal [2] | Coke | Coal [2] |
| 100 | 62.2 | 88.9 | 64.3 | 91.9 | 62.7 | 89.6 | 64.4 | 92.0 |
| 90 | 56.0 | 80.0 | 57.9 | 82.7 | 56.4 | 80.6 | 58.0 | 82.8 |
| 85 | 52.9 | 75.6 | 54.7 | 78.1 | 53.3 | 76.2 | 54.7 | 78.2 |
| 75 | 46.7 | 66.7 | 48.2 | 68.9 | 47.0 | 67.2 | 48.3 | 69.0 |
| 50 | 31.1 | 44.5 | 32.2 | 46.0 | 31.4 | 44.8 | 32.2 | 46.0 |

[1] Figures for 1938 not yet available.
[2] Coal for charge estimated on basis of 70-percent yield in coke.

TABLE 17.—*Relation (percent) of production to maximum capacity at byproduct coke plants, 1929 and 1935–38, by months*

| Month | 1929 | 1935 | 1936 | 1937 | 1938 | Month | 1929 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 88.6 | 52.5 | 62.4 | 83.0 | 52.4 | August | 93.6 | 52.1 | 74.2 | 86.0 | 47.3 |
| February | 91.3 | 57.7 | 63.3 | 83.5 | 52.3 | September | 91.9 | 55.0 | 76.0 | 86.1 | 52.4 |
| March | 93.0 | 54.6 | 61.5 | 84.9 | 50.7 | October | 92.3 | 57.2 | 78.1 | 76.0 | 57.9 |
| April | 92.8 | 51.7 | 67.6 | 84.9 | 47.7 | November | 89.0 | 60.3 | 80.3 | 62.8 | 63.3 |
| May | 94.0 | 52.4 | 70.8 | 84.6 | 43.2 | December | 83.1 | 63.1 | 83.4 | 53.1 | 62.8 |
| June | 93.9 | 50.4 | 72.1 | 78.6 | 40.4 | | | | | | |
| July | 93.0 | 48.2 | 71.5 | 83.2 | 41.3 | The year | 91.4 | 54.6 | 71.6 | 78.8 | 51.0 |

## QUANTITY AND COST OF COAL CHARGED

Although the quantity of coal used in the manufacture of coke has fluctuated widely in the past decade the proportion of total output of bituminous coal carbonized each year has remained remarkably constant, ranging from 10.3 to 16.2 percent, with an average of 13.7 percent, for the 5-year period 1929–33, inclusive, and from 12.8 to 16.8 percent, with an average of 14.5 percent, for 1934–38. In 1938 the proportion fell slightly below the average for the 10-year period (14.1 percent). In that year coke ovens consumed 46,352,700 tons or only 13.5 percent of the total output of bituminous coal. Of this quantity 44,992,800 tons were used in byproduct ovens.

The cost of coal constitutes the chief item of expense in the manufacture of coke. In 1937 the cost of raw coal f. o. b. ovens ranged from $1.86 in Virginia, where all the coke is made in beehive ovens at the mines, to $5.24 in Minnesota, where the cost includes heavy freight charges from distant mines.

The average cost of coal in byproduct ovens in 1937 was $3.74 a ton, and the cost of the coal equivalent of 1 ton of merchantable coke was $5.27. The corresponding figures for beehive coke were $2.01 and $3.14, respectively. In 1938 the cost of the coal consumed at beehive ovens had risen to $2.05, and the cost of the coal equivalent per ton of coke rose in turn to $3.32.

The Bureau of Mines has been determining the expanding properties of coal, particularly of samples received in connection with the survey of gas- and coke-making properties of American coals. A recent

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report of investigations on the expansion of coal during coking [2] will be of value to readers interested in the technology of the coke industry.

TABLE 18.—*Coal consumed in coke ovens, 1936–38, by months, in net tons*

[For figures, 1912–30, inclusive, see Coke and Byproducts in 1928, pp. 731–733, and Coke and Byproducts in 1930, p. 514]

| Month | 1936 | | | 1937 | | | 1938 [1] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Byproduct | Beehive | Total | Byproduct | Beehive | Total | Byproduct | Beehive | Total |
| January | 4,710,400 | 209,900 | 4,920,300 | 6,198,700 | 426,600 | 6,625,300 | 3,922,600 | 184,400 | 4,107,000 |
| February | 4,470,100 | 227,600 | 4,697,700 | 5,679,900 | 458,500 | 6,138,400 | 3,539,200 | 164,700 | 3,703,900 |
| March | 4,634,500 | 162,300 | 4,796,800 | 6,387,000 | 556,800 | 6,943,800 | 3,795,000 | 153,200 | 3,948,200 |
| April | 4,935,800 | 134,100 | 5,069,900 | 6,183,800 | 480,800 | 6,664,600 | 3,456,500 | 117,600 | 3,574,100 |
| May | 5,346,100 | 126,900 | 5,473,000 | 6,368,500 | 509,700 | 6,878,200 | 3,235,800 | 92,000 | 3,327,800 |
| June | 5,263,900 | 137,600 | 5,401,500 | 5,729,200 | 430,500 | 6,159,700 | 2,930,800 | 81,500 | 3,012,300 |
| July | 5,271,100 | 165,200 | 5,436,300 | 6,217,200 | 441,700 | 6,658,900 | 3,085,200 | 68,700 | 3,153,900 |
| August | 5,484,200 | 190,700 | 5,674,900 | 6,425,800 | 401,100 | 6,826,900 | 3,534,100 | 78,900 | 3,613,000 |
| September | 5,435,700 | 244,000 | 5,679,700 | 6,220,700 | 392,800 | 6,613,500 | 3,769,700 | 87,700 | 3,857,400 |
| October | 5,777,100 | 353,100 | 6,130,200 | 5,664,800 | 351,600 | 6,016,400 | 4,360,200 | 99,700 | 4,459,900 |
| November | 5,744,300 | 357,900 | 6,102,200 | 4,527,000 | 264,000 | 4,791,000 | 4,622,100 | 109,100 | 4,731,200 |
| December | 6,170,300 | 388,900 | 6,559,200 | 3,972,800 | 212,700 | 4,185,500 | 4,741,600 | 122,400 | 4,864,000 |
| | 63,243,500 | 2,698,200 | 65,941,700 | 69,575,400 | 4,926,800 | 74,502,200 | 44,992,800 | 1,359,900 | 46,352,700 |

[1] Subject to revision.

TABLE 19.—*Total quantity and value at ovens of coal used in manufacture of coke, by States, in 1937* [1]

| State | Coal used (net tons) | Cost of coal | | Coal per ton of coke | |
|---|---|---|---|---|---|
| | | Total | Per ton of coal | Net tons | Cost |
| Byproduct plants: | | | | | |
| Alabama | 5,886,198 | $13,692,329 | $2.33 | 1.38 | $3.22 |
| Colorado | 722,865 | (2) | (2) | 1.48 | (2) |
| Illinois | 4,251,016 | 19,654,569 | 4.62 | 1.42 | 6.56 |
| Indiana | 7,588,989 | 35,716,558 | 4.71 | 1.39 | 6.55 |
| Maryland | 2,084,471 | (2) | (2) | 1.38 | (2) |
| Massachusetts | 1,615,444 | (2) | (2) | 1.43 | (2) |
| Michigan | 3,213,934 | 13,379,059 | 4.16 | 1.41 | 5.87 |
| Minnesota | 1,002,812 | 5,256,607 | 5.24 | 1.42 | 7.44 |
| New Jersey | 1,434,022 | (2) | (2) | 1.41 | (2) |
| New York | 6,894,332 | 31,397,888 | 4.55 | 1.39 | 6.32 |
| Ohio | 9,409,187 | 35,398,011 | 3.76 | 1.40 | 5.26 |
| Pennsylvania | 19,907,104 | 59,342,834 | 2.98 | 1.45 | 4.32 |
| Tennessee | 129,635 | 443,939 | 3.42 | 1.45 | 4.96 |
| Utah | 264,070 | (2) | (2) | 1.76 | (2) |
| Washington | 26,118 | 127,258 | 4.87 | 1.78 | 8.67 |
| West Virginia | 2,572,329 | 6,530,791 | 2.54 | 1.41 | 3.58 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 2,572,847 | 11,611,196 | 4.51 | 1.36 | 6.13 |
| Undistributed | | 27,902,659 | 4.56 | | 6.48 |
| Total byproduct | 69,575,373 | 260,453,698 | 3.74 | 1.41 | 5.27 |
| At merchant plants | 18,201,810 | 80,027,136 | 4.40 | 1.39 | 6.12 |
| At furnace plants | 51,373,563 | 180,426,562 | 3.51 | 1.42 | 4.98 |
| Beehive plants: | | | | | |
| Colorado and Utah | 127,549 | 376,593 | 2.95 | 1.80 | 5.31 |
| Pennsylvania | 3,906,754 | 7,811,286 | 2.00 | 1.53 | 3.06 |
| Tennessee | 27,803 | 49,033 | 1.76 | 1.86 | 3.27 |
| Virginia | 412,192 | 767,380 | 1.86 | 1.71 | 3.18 |
| West Virginia | 452,526 | 882,124 | 1.95 | 1.62 | 3.16 |
| Total beehive | 4,926,824 | 9,886,416 | 2.01 | 1.56 | 3.14 |

[1] Figures for 1938 not yet available. [2] Included under "Undistributed."

[2] Auvil, H. S., Davis, J. D., and McCartney, J. T., Expansion of Coal During Coking: Bureau of Mines Rept. of Investigations 3451, 1939, 21 pp.

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TABLE 20.—*Average cost per net ton of coal charged into byproduct coke ovens, by States, 1929 and 1934–37* [1]

| State | 1929 | 1934 | 1935 | 1936 | 1937 | State | 1929 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | $2.49 | $2.28 | $2.37 | $2.24 | $2.33 | Pennsylvania | $2.73 | $3.04 | $2.98 | $2.94 | $2.98 |
| Illinois | 4.29 | 4.49 | 4.62 | 4.43 | 4.62 | Tennessee | 3.02 | 3.18 | 3.73 | 3.35 | 3.42 |
| Indiana | 4.61 | 4.48 | 4.66 | 4.60 | 4.71 | Washington | 5.26 | 4.60 | 4.75 | 4.81 | 4.87 |
| Massachusetts | 4.70 | 4.81 | 5.02 | 4.98 | (2) | West Virginia | 2.41 | 2.07 | 2.20 | 2.37 | 2.54 |
| Michigan | 4.29 | 4.13 | 4.28 | 4.28 | 4.16 | | | | | | |
| Minnesota | 5.04 | (2) | (2) | 5.28 | 5.24 | United States average | 3.50 | 3.70 | 3.82 | 3.69 | 3.74 |
| New York | 4.22 | 4.35 | 4.57 | 4.45 | 4.55 | | | | | | |
| Ohio | 3.31 | 3.49 | 3.66 | 3.60 | 3.76 | Cost of coal per ton of coke | 5.04 | 5.33 | 5.46 | 5.24 | 5.27 |

[1] Figures for 1938 not yet available.
[2] Bureau of Mines not at liberty to publish data.

## PREPARATION AND SOURCE OF COAL

In Alabama, Colorado, Tennessee, and Washington and certain parts of Illinois, New York, Ohio, and Pennsylvania the coal used for coking is washed before it is charged in the ovens. The washing sometimes is done by the coal operator at the mine and sometimes by the coke producer at the plant. For the country as a whole in 1937, 25 percent of the coal used in byproduct ovens and 18 percent of that in beehive ovens was washed before charging. In 1938 operators of beehive plants reported that 427,858 tons—31 percent of a total of 1,359,876 tons—were washed before coking.

TABLE 21.—*Washed and unwashed coal used in the manufacture of byproduct and beehive coke, by States in which used, in 1937, in net tons* [1]

| State | Washed | Unwashed | Total |
|---|---|---|---|
| Byproduct ovens: | | | |
| Alabama | 5,288,498 | 597,700 | 5,886,198 |
| Colorado | 722,865 | | 722,865 |
| Illinois | 348,648 | 3,902,368 | 4,251,016 |
| Indiana | | 7,588,989 | 7,588,989 |
| Maryland | | 2,084,471 | 2,084,471 |
| Massachusetts | | 1,615,444 | 1,615,444 |
| Michigan | | 3,213,934 | 3,213,934 |
| Minnesota | | 1,002,812 | 1,002,812 |
| New Jersey | | 1,434,022 | 1,434,022 |
| New York | 942,110 | 5,952,222 | 6,894,332 |
| Ohio | 1,385,530 | 8,023,657 | 9,409,187 |
| Pennsylvania | 8,326,663 | 11,580,441 | 19,907,104 |
| Tennessee | 129,635 | | 129,635 |
| Utah | | 264,070 | 264,070 |
| Washington | 26,118 | | 26,118 |
| West Virginia | 59,727 | 2,512,602 | 2,572,329 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 27,021 | 2,545,826 | 2,572,847 |
| Total byproduct | 17,256,815 | 52,318,558 | 69,575.373 |
| At merchant plants | 1,650,160 | 16,551,650 | 18,201,810 |
| At furnace plants | 15,606,655 | 35,766,908 | 51,373,563 |
| Beehive ovens: | | | |
| Colorado | 115,278 | | 115,278 |
| Pennsylvania | 730,707 | 3,176,047 | 3,906,754 |
| Tennessee | 27,803 | | 27,803 |
| Utah | | 12,271 | 12,271 |
| Virginia | | 412,192 | 412,192 |
| Washington | | | |
| West Virginia | | 452,526 | 452,526 |
| Total beehive | 873,788 | 4,053,036 | 4,926,824 |

[1] Figures for 1938 not yet available.

The Appalachian fields remain the principal source of byproduct coal, although it is interesting to note that in 1937 small amounts were drawn from Illinois and Ohio. States that are not rated as

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producers of coking coal; and larger amounts came from the western portion of the United States (Colorado, New Mexico, Utah, and Washington). The total supplies from these four Western States amounted to 1,030,755 tons—less than 2 percent of the total.

Pennsylvania headed the list of States in volume of supplies with 43 percent of the total, followed by West Virginia with 35 percent, Kentucky with 11 percent, and Alabama with 8 percent. Other States producing coking coal supplied less than a million tons each.

TABLE 22.—*Coal used in manufacture of byproduct coke in 1937, by fields of origin, in net tons* [1]

[Based upon detailed reports from each coke plant. The difference between these totals and those shown in tables 1, 9, 19, etc., is due to change in stock, loss of weight in handling, and the fact that these sometimes represent purchases during the year rather than actual consumption]

| State and district where coal was produced | Total used | States where coal was consumed, in order of importance |
|---|---|---|
| Alabama | 5,802,069 | Alabama. |
| Colorado: | | |
| Canon, Crested Butte, and Walsen | 135,155 | Colorado. |
| Trinidad | 578,420 | Do. |
| Illinois: Franklin County | 103,663 | Illinois. |
| Kentucky: | | |
| Eastern Kentucky: | | |
| Elkhorn (including Hazard) | 2,013,310 | Indiana, New York, Ohio, Kentucky, Michigan, Missouri, New Jersey, Minnesota, and Illinois. |
| Harlan | 3,484,375 | Indiana, Illinois, Michigan, Minnesota, and New York. |
| Kenova-Thacker [2] | 1,762,589 | Michigan, Ohio, Wisconsin, Massachusetts, Minnesota, West Virginia, and Kentucky. |
| Miscellaneous | 638,800 | Indiana. |
| New Mexico: Raton-Trinidad | 9,290 | Colorado. |
| Ohio | 503 | Ohio. |
| Pennsylvania: | | |
| Central Pennsylvania: | | |
| High volatile | 53,714 | New York. |
| Medium volatile | 861,641 | New York and Pennsylvania. |
| Low volatile | 1,458,864 | Pennsylvania, Maryland, New York, and West Virginia. |
| Connellsville | 15,167,424 | Pennsylvania, Ohio, West Virginia, New York, Illinois, Minnesota, Michigan, and New Jersey. |
| Freeport | 1,555,926 | West Virginia, New York, Ohio, Michigan, and Pennsylvania. |
| Pittsburgh | 9,154,109 | Pennsylvania, New York, Ohio, Michigan, Illinois, Minnesota, Wisconsin, and Indiana. |
| Somerset | 617,358 | Pennsylvania, West Virginia, and Ohio. |
| Westmoreland | 1,364,765 | Pennsylvania, Maryland, and New York. |
| Miscellaneous | 8,168 | Pennsylvania. |
| Tennessee | 110,390 | Tennessee. |
| Utah: Carbon County | 285,430 | Utah. |
| Virginia: [2 3] | | |
| Southwestern Virginia | 281,396 | New Jersey and New York. |
| Washington: Pierce County | 22,460 | Washington. |
| West Virginia: [2 3] | | |
| Coal and coke [4] | 150,226 | Pennsylvania and Minnesota. |
| Kanawha and Logan (including Coal River). | 8,396,995 | Indiana, Illinois, Massachusetts, Ohio, New York, New Jersey, West Virginia, Connecticut, Michigan, Wisconsin, Pennsylvania, Minnesota, Rhode Island, Kentucky, and Missouri. |
| New River and Winding Gulf | 2,114,150 | Massachusetts, New York, Illinois, New Jersey, Missouri, Rhode Island, Pennsylvania, Minnesota, Kentucky, Indiana, Michigan, and Ohio. |
| Northern | 2,827,290 | Pennsylvania, Maryland, Ohio, West Virginia, Illinois, and New York. |
| Pocahontas [3] | 10,969,509 | Indiana, Ohio, Illinois, New York, Michigan, Maryland, Pennsylvania, Wisconsin, Minnesota, West Virginia, Kentucky, Connecticut, Alabama, Massachusetts, and Tennessee. |
| Webster-Gauley | 249,988 | Pennsylvania. |
| | 70,177,977 | |

[1] Figures for 1938 not yet available.
[2] Tonnage from the extension of Thacker field in Virginia and West Virginia is included under Kenova-Thacker (Kentucky).
[3] Coal from the extension of the Pocahontas field in Tazwell County, Va., is included under West Virginia (Pocahontas).
[4] Includes tonnage from all of U. S. Coal Commission field 24a-b-c except Webster-Gauley.

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TABLE 23.—*Source of coal used in the manufacture of byproduct coke in 1937, by States where consumed, separating merchant and furnace plants* [1]

| State where coal was used | Coal produced in— | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alabama | Colorado | Illinois | Kentucky | New Mexico | Ohio | Pennsylvania | Tennessee | Utah | Virginia | Washington | West Virginia | Total |
| Alabama: | | | | | | | | | | | | | |
| Merchant plants | 1,337,927 | | | | | | | | | | | 105,303 | 1,443,230 |
| Furnace plants | 4,464,142 | | | | | | | | | | | 15,056 | 4,479,198 |
| Total Alabama | 5,802,069 | | | | | | | | | | | 120,359 | 5,922,428 |
| Colorado: Furnace plants | | 713,575 | | | 9,290 | | | | | | | | 722,865 |
| Illinois: | | | | | | | | | | | | | |
| Merchant plants | | | 103,663 | 222,192 | | | 96,744 | | | | | 1,652,050 | 2,074,649 |
| Furnace plants | | | | 854,376 | | | 395,120 | | | | | 1,046,206 | 2,295,702 |
| Total Illinois | | | 103,663 | 1,076,568 | | | 491,864 | | | | | 2,698,256 | 4,370,351 |
| Indiana: | | | | | | | | | | | | | |
| Merchant plants | | | | | | | | | | | | 760,215 | 760,215 |
| Furnace plants | | | | 3,409,932 | | | 20,844 | | | 339,657 | | 3,253,770 | 7,024,203 |
| Total Indiana | | | | 3,409,932 | | | 20,844 | | | 339,657 | | 4,013,985 | 7,784,418 |
| Maryland: Furnace plants | | | | | | | 578,299 | | | | | 1,506,172 | 2,084,471 |
| Massachusetts: Merchant plants | | | | | | | | | | | | 1,616,700 | 1,616,700 |
| Michigan: | | | | | | | | | | | | | |
| Merchant plants | | | | 300,033 | | | 306,477 | | | (2) | | 805,922 | [3] 1,412,432 |
| Furnace plants | | | | 1,208,334 | | | | | | | | 307,629 | 1,515,963 |
| Total Michigan | | | | 1,508,367 | | | 306,477 | | | (2) | | 1,113,551 | [3] 2,928,395 |
| Minnesota: | | | | | | | | | | | | | |
| Merchant plants | | | | 51,558 | | | | | | | | 409,707 | 461,265 |
| Furnace plants | | | | 145,207 | | | 196,735 | | | | | 129,890 | 471,832 |
| Total Minnesota | | | | 196,765 | | | 196,735 | | | | | 539,597 | 933,097 |
| New Jersey: Merchant plants | | | | 53,293 | | | 16,390 | | | 143,339 | | 1,264,958 | 1,477,980 |
| New York: | | | | | | | | | | | | | |
| Merchant plants | | | | 275,040 | | | 1,933,025 | | | 138,057 | | 1,502,819 | 3,848,941 |
| Furnace plants | | | | | | | 2,397,111 | | | | | 930,730 | 3,327,841 |
| Total New York | | | | 275,040 | | | 4,330,136 | | | 138,057 | | 2,433,549 | 7,176,782 |

See footnotes at end of table.

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TABLE 23.—*Source of coal used in the manufacture of byproduct coke in 1937, by States where consumed, separating merchant and furnace plants.*—Continued

| State where coal was used | Coal produced in— | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alabama | Colorado | Illinois | Kentucky | New Mexico | Ohio | Pennsylvania | Tennessee | Utah | Virginia | Washington | West Virginia | Total |
| Ohio: | | | | | | | | | | | | | |
| Merchant plants | | | | | | | | | | [2] | | 755,882 | [3] 755,882 |
| Furnace plants | | | | 527,997 | | 503 | 4,839,322 | | | | | 3,201,066 | 8,568,888 |
| Total Ohio | | | | 527,997 | | 503 | 4,839,322 | | | [2] | | 3,956,948 | [3] 9,324,770 |
| Pennsylvania: | | | | | | | | | | | | | |
| Merchant plants | | | | | | | 33,481 | | | | | 768,721 | 802,202 |
| Furnace plants | | | | | | | 17,659,965 | | | | | 1,428,104 | 19,088,069 |
| Total Pennsylvania | | | | | | | 17,693,446 | | | | | 2,196,825 | 19,890,271 |
| Tennessee: Merchant plants | | | | | | | | 110,390 | | | | 33,056 | 143,446 |
| Utah: Furnace plants | | | | | | | | | 285,430 | | | | 285,430 |
| Washington: Merchant plants | | | | | | | | | | | 22,460 | | 22,460 |
| West Virginia: | | | | | | | | | | | | | |
| Merchant plants | | | | | | | 32,243 | | | | | 734,706 | 766,949 |
| Furnace plants | | | | 12,169 | | | 1,709,192 | | | | | 112,769 | 1,834,130 |
| Total West Virginia | | | | 12,169 | | | 1,741,435 | | | | | 847,475 | 2,601,079 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: | | | | | | | | | | | | | |
| Merchant plants | | | | 496,855 | | | 27,021 | | | 907 | | 2,051,803 | 2,576,586 |
| Undistributed: Merchant plants | | | | | | | | | | 316,448 | | | 316,448 |
| Grand total | 5,802,069 | 713,575 | 103,663 | 7,556,986 | 9,290 | 503 | 30,241,969 | 110,390 | 285,430 | 938,408 | 22,460 | 24,393,234 | 70,177,977 |
| Merchant plants | 1,337,927 | | 103,663 | 1,398,971 | | | 2,445,381 | 110,390 | | 598,751 | 22,460 | 12,461,842 | 18,479,385 |
| Furnace plants | 4,464,142 | 713,575 | | 6,158,015 | 9,290 | 503 | 27,796,588 | | 285,430 | 339,657 | | 11,931,392 | 51,698,592 |

[1] Figures for 1938 not yet available.

[2] Included under "Undistributed."

[3] Excludes items included under "Undistributed."

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## YIELD OF COKE PER TON OF COAL

TABLE 24.—*Percentage yield of coke from coal in byproduct and beehive ovens, by States, 1934–37* [1]

| State | 1934 | | 1935 | | 1936 | | 1937 | |
|---|---|---|---|---|---|---|---|---|
| | Byproduct | Beehive | Byproduct | Beehive | Byproduct | Beehive | Byproduct | Beehive |
| Alabama | 69.73 | | 68.91 | | 69.66 | | 72.37 | |
| Colorado | 66.21 | 65.17 | 68.22 | 64.91 | 66.68 | 65.25 | 67.36 | 55.71 |
| Illinois | 67.46 | | 67.30 | | 68.62 | | 70.54 | |
| Indiana | 71.42 | | 71.97 | | 73.54 | | 72.04 | |
| Maryland | 71.30 | | 72.43 | | 72.28 | | 72.62 | |
| Massachusetts | 71.21 | | 70.31 | | 70.74 | | 69.99 | |
| Michigan | 70.56 | | 70.56 | | 71.91 | | 71.05 | |
| Minnesota | 68.46 | | 68.29 | | 69.22 | | 70.27 | |
| New Jersey | 70.29 | | 71.35 | | 71.08 | | 70.78 | |
| New York | 69.76 | | 70.08 | | 71.85 | | 71.75 | |
| Ohio | 70.42 | | 70.83 | | 71.25 | | 71.61 | |
| Pennsylvania | 67.78 | 64.08 | 67.84 | 63.99 | 68.39 | 64.56 | 68.83 | 65.50 |
| Tennessee | 69.91 | 47.94 | 69.31 | 51.25 | 68.95 | 51.80 | 69.00 | 53.89 |
| Utah | 60.47 | 52.49 | 59.78 | 47.21 | 56.88 | 57.59 | 56.67 | 54.25 |
| Virginia | | 59.39 | | 58.63 | | 57.96 | | 58.33 |
| Washington | 54.37 | 63.07 | 60.78 | 62.22 | 60.38 | 62.28 | 56.11 | |
| West Virginia | 67.79 | 61.00 | 69.89 | 60.85 | 70.19 | 61.06 | 70.67 | 61.74 |
| United States average | 69.44 | 62.90 | 69.78 | 62.44 | 70.47 | 63.23 | 70.73 | 64.23 |

[1] Figures for 1938 not yet available.



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## COKE BREEZE

TABLE 25.—*Coke breeze recovered at coke plants in 1937, by States* [1]

| State | Yield per ton of coal (percent) | Produced | | Used by producer | | | | Sold | | Wasted (net tons) | On hand Dec. 31 (net tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | For steam raising | | For other purposes, including water gas | | | | | |
| | | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value | | |
| Byproduct ovens: | | | | | | | | | | | |
| Alabama | 4.86 | 286,194 | $432,599 | 124,597 | $160,504 | 6,816 | $10,748 | 162,035 | $260,672 | 12,914 | 29,841 |
| Colorado | 5.42 | 39,182 | (2) | 25,887 | (2) | | | 13,295 | (2) | | |
| Illinois | 6.13 | 260,789 | 569,139 | 153,663 | 374,867 | 44,877 | 81,099 | 79,443 | 165,120 | | 43,048 |
| Indiana | 5.46 | 414,435 | 1,026,836 | 240,906 | 537,809 | 124,433 | 258,275 | 54,769 | 250,197 | | 16,314 |
| Maryland | 6.55 | 136,619 | (2) | 81,981 | (2) | 23,041 | (2) | | | 9,847 | 28,085 |
| Massachusetts | 7.60 | 122,771 | (2) | 78,131 | (2) | 7,534 | (2) | 36,344 | (2) | | 2,973 |
| Michigan | 5.19 | 166,736 | 703,696 | 85,632 | 340,189 | 6,547 | 37,735 | 31,017 | 84,533 | | 10,041 |
| Minnesota | 5.98 | 59,952 | 183,017 | 30,571 | 83,003 | 6,094 | 18,414 | 21,471 | 74,794 | | 16,264 |
| New Jersey | 6.19 | 88,739 | (2) | 74,522 | (2) | | | 8,259 | (2) | | 11,937 |
| New York | 4.39 | 302,646 | 776,492 | 176,640 | 417,224 | 63,970 | 191,356 | 73,171 | 189,227 | | 45,807 |
| Ohio | 5.01 | 471,174 | 968,485 | 371,222 | 769,309 | 66,385 | 131,341 | 48,065 | 91,522 | | 30,337 |
| Pennsylvania | 6.15 | 1,224,772 | 1,799,239 | 1,085,166 | 1,560,850 | 66,442 | 93,536 | 81,360 | 154,046 | | 29,447 |
| Tennessee | 3.58 | 4,641 | 6,962 | 5,496 | 8,244 | | | | | | 1,373 |
| Utah | 6.92 | 18,272 | (2) | 5,252 | (2) | 4,418 | (2) | 9,459 | (2) | | 109 |
| Washington | 13.88 | 3,625 | 10,549 | 4,247 | 12,382 | 309 | 895 | | | | 48 |
| West Virginia | 3.90 | 100,413 | 136,877 | 89,419 | 122,995 | 5,295 | 8,682 | 89 | 165 | | 3,270 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 7.10 | 182,738 | 578,347 | 121,201 | 349,183 | 24,938 | 119,690 | 38,368 | 118,300 | | 8,473 |
| Undistributed | | | 762,370 | | 486,537 | | 60,722 | | 146,561 | | |
| Total byproduct, 1937 | 5.58 | 3,883,698 | 7,954,608 | 2,754,533 | 5,223,096 | 451,099 | 1,012,493 | 657,145 | 1,535,137 | 22,761 | 277,367 |
| At merchant plants | 5.97 | 1,085,786 | 2,755,786 | 650,291 | 1,658,017 | 123,093 | 346,105 | 321,980 | 776,182 | | 129,129 |
| At furnace plants | 5.45 | 2,797,912 | 5,198,822 | 2,104,242 | 3,565,079 | 328,006 | 666,388 | 335,165 | 758,955 | 22,761 | 148,238 |
| Total byproduct, 1936 | 5.66 | 3,577,222 | 7,265,615 | 2,581,230 | 5,111,445 | 369,410 | 857,732 | 697,918 | 1,477,045 | 9,006 | 285,775 |
| Change in 1937 ..... percent | −1.4 | +8.6 | +9.5 | +6.7 | +2.2 | +22.1 | +18.0 | −5.8 | +3.9 | +152.7 | −2.9 |
| Beehive ovens: | | | | | | | | | | | |
| Colorado and Utah | [3] 2.36 | 3,016 | 4,531 | | | 1,129 | 1,129 | 1,769 | 3,190 | | 848 |
| Pennsylvania | [3] 4.54 | 88,942 | 108,229 | 5,650 | 6,935 | 1,239 | 251 | 42,383 | 50,520 | 35,581 | 6,186 |
| Virginia | [3] 2.64 | 6,365 | 19,727 | 136 | 579 | 25 | 109 | 6,204 | 19,039 | | 20 |
| West Virginia | [3] 3.86 | 2,734 | 573 | | | | | 2,734 | 573 | | 112 |
| Total beehive, 1937 | [3] 4.21 | 101,057 | 133,060 | 5,786 | 7,514 | 2,393 | 1,489 | 53,090 | 73,322 | [4] 35,581 | 7,166 |

[1] Figures for 1938 not yet available.
[2] Included under "Undistributed."
[3] Yield computed by dividing production of breeze at the few plants reporting by the quantity of coal charged at these plants.
[4] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources, 1922, pt. 2, pp. 726-727.

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## CONSUMPTION OF COKE

Allowing for imports and exports and for changes in producers' stocks the indicated consumption of coke in 1938 was 31,222,635 tons. Of this amount 16,995,777 tons (about 54 percent of the total) were, according to figures compiled by the American Iron and Steel Institute, consumed by blast furnaces in the manufacture of pig iron and ferro-alloys. The remainder—14,226,858 tons (46 percent)—was used in foundries, in smelting the nonferrous metals, in the manufacture of water gas, in miscellaneous other industrial uses, and for domestic heating.

The consumption of coke for purposes other than iron manufacture has increased notably in recent years. In 1913 the total used for nonfurnace purposes was only 18 percent; by 1930 it had risen to 30 percent and by 1938 to 46 percent.

The noteworthy improvement in efficiency of fuel utilization in blast-furnace operations during recent years is shown clearly by the fact that the quantity of coking coal required to make 1 gross ton of pig iron declined from an average of 3,637.2 pounds in 1913 to 2,865.1 in 1938.

TABLE 26.—*Coke consumed in manufacture of pig iron and for other purposes, 1913, 1918, and 1936–38, in net tons*

| Year | Total production of coke | Imports | Exports | Net changes in stocks | Indicated United States consumption [1] | Consumed by iron furnaces [2] | | Remainder consumed in other ways | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Quantity | Percent | Quantity | Percent |
| 1913 | 46,299,530 | 101,212 | 987,395 | [3] | 45,413,347 | 37,192,287 | 81.9 | 8,221,060 | 18.1 |
| 1918 | 56,478,372 | 30,168 | 1,687,824 | [3] | 54,820,716 | 45,703,594 | 83.4 | 9,117,122 | 16.6 |
| 1936 | 46,275,184 | 329,957 | 670,312 | −1,097,318 | 47,032,147 | 31,255,648 | 66.5 | 15,776,499 | 33.5 |
| 1937 | 52,375,469 | 286,364 | 526,683 | +863,221 | 51,271,929 | 33,571,349 | 65.5 | 17,700,580 | 34.5 |
| 1938 [4] | 32,633,304 | 135,240 | 486,571 | +1,059,338 | 31,222,635 | 16,995,777 | 54.4 | 14,226,858 | 45.6 |

[1] Production plus imports minus exports, plus or minus the decrease or increase, respectively, of the net changes in stocks.
[2] From Report of American Iron and Steel Institute. Figures include coke consumed in the manufacture of ferro-alloys.
[3] Data not available. [4] Subject to revision.

TABLE 27.—*Pounds of coke and coking coal consumed per gross ton of pig iron made in the United States, 1913, 1918, and 1936–38*

| Year | Pounds of coke per gross ton of pig iron and ferro-alloys [1] | Percent yield of coke from coal | Calculated pounds coking coal per gross ton of pig iron and ferro-alloys | Year | Pounds of coke per gross ton of pig iron and ferro-alloys [1] | Percent yield of coke from coal | Calculated pounds coking coal per gross ton of pig iron and ferro-alloys |
|---|---|---|---|---|---|---|---|
| 1913 | 2,433.3 | 66.9 | 3,637.2 | 1937 | 2,050.3 | 70.3 | 2,916.5 |
| 1918 | 2,375.2 | 66.4 | 3,577.1 | 1938 [2] | 2,017.1 | 70.4 | 2,865.1 |
| 1936 | 2,036.2 | 70.2 | 2,900.6 | | | | |

[1] From Report of American Iron and Steel Institute; the consumption per ton of pig iron only, excluding the furnaces making ferro-alloys, was 2,433.3 in 1913, 2,375.2 in 1918, 2,006.2 in 1936, 2,023.5 in 1937, and 1,987.6 in 1938.
[2] Subject to revision.

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## FURNACE, FOUNDRY, DOMESTIC, AND OTHER COKE

The terms "furnace coke" and "foundry coke," as used in the trade, refer to the size and grade of the coke as well as to the use for which it may be intended. Byproduct furnace coke ordinarily is run-of-oven coke from which the breeze and all small coke less than, say, three-fourths inch in diameter have been removed. Byproduct foundry coke ordinarily is a blocky coke of maximum size much greater than that of furnace coke, from which all sizes under 2½ to 3 inches are screened out. Coke of smaller size than furnace or foundry (exclusive, however, of breeze) often is called domestic coke. It may result from the screening of foundry or furnace coke or, where the principal demand is for domestic coke, may be obtained by crushing the larger fragments. Other special sizes and grades may be prepared for special purposes. Thus, not all furnace coke finds its way to blast furnaces or all foundry coke to iron foundries proper, for either grade may be purchased by other classes of consumers.

Coke enters the domestic fuel market mainly under two conditions: (1) In or near areas of surplus metallurgical coke production and (2) in localities where the manufacture and distribution of large quantities of city gas results in the production of correspondingly large quantities of coke. Since this fuel is, on the average, not transported as far as coal, its consumption for domestic purposes tends to be localized in regions near the centers of production. In recent years the majority of the coke operators have reported that their plants are equipped to screen and size coke for domestic use.

In years of heavy blast-furnace activity (such as 1937) the coke plants owned by or having contracts with steel interests concentrate on the production of furnace coke, and less is available for domestic and industrial use. When the reverse is true, as in 1938, the surplus metallurgical coke is thrown on the open market, sometimes at a lower-than-cost price. Thus, in 1933 only 54 percent of the total amount sold or used at coke plants was for blast-furnace use, and 43 percent was for domestic and other industrial use. In 1937 furnace coke at byproduct plants constituted 77 percent of the total, and 19 percent went for domestic and other industrial purposes. At beehive plants in the same year 65 percent was furnace and 24 percent domestic and other industrial. For the year 1938 only 37 percent of beehive coke went to blast furnaces, while 44 percent was sold for general domestic and industrial purposes. Complete figures are not yet available for the byproduct coke industry in 1938. It is known, however, that about 7,100,000 tons of coke were sold for domestic purposes in that year, a decrease of only 9 percent over 1937 compared with a general decrease of 35 percent in the total production of byproduct coke.

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TABLE 28.—*Byproduct coke produced and sold or used by producer in 1937, by States* [1]

[Exclusive of screenings or breeze]

| State | Produced | | Used by producer in blast furnace [2] | | Sold | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Furnace [3] | | Foundry | | Domestic use | | Industrial and other use (including water gas) [4] | | Total | |
| | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value |
| Alabama | 4,259,771 | $13,275,098 | 2,861,130 | $8,105,027 | 606,174 | $1,409,992 | 243,705 | $1,668,296 | 242,538 | $1,018,106 | 159,351 | $585,930 | 1,251,768 | $4,682,324 |
| Colorado | 486,945 | (5) | 454,035 | (5) | | | 9,778 | (5) | 1,992 | (5) | 19,597 | (5) | 31,367 | (5) |
| Illinois | 2,998,663 | 20,213,129 | 1,870,425 | 11,904,163 | 10,753 | 73,320 | 230,668 | 2,229,631 | 781,056 | 5,300,860 | 61,672 | 415,567 | 1,084,149 | 8,019,378 |
| Indiana | 5,467,061 | 32,655,355 | 4,859,558 | 28,143,022 | (5) | (5) | 227,726 | 2,088,487 | 330,581 | 2,049,818 | (5) | (5) | 602,702 | 4,478,920 |
| Maryland | 1,513,651 | (5) | 1,439,740 | (5) | | | | | | | 39,972 | (5) | 39,972 | (5) |
| Massachusetts | 1,130,620 | (5) | 156,779 | (5) | 19,723 | (5) | 53,252 | (5) | 865,660 | (5) | 39,549 | (5) | 978,184 | (5) |
| Michigan | 2,283,518 | 13,816,401 | 582,344 | 3,362,884 | (5) | (5) | (5) | (5) | 1,037,602 | 6,425,361 | 180,523 | 1,109,501 | 1,628,886 | 10,019,165 |
| Minnesota | 704,631 | 5,611,287 | 240,629 | 1,459,134 | | | 175 | 1,644 | 359,948 | 3,297,761 | 17,578 | 134,643 | 377,701 | 3,434,048 |
| New Jersey | 1,015,073 | (5) | 177,625 | (5) | 34,872 | (5) | 34,143 | (5) | 521,084 | (5) | 237,310 | (5) | 827,409 | (5) |
| New York | 4,946,964 | 29,853,516 | 1,638,041 | 8,951,715 | 1,585,028 | 8,735,397 | (5) | (5) | 1,367,705 | 9,567,800 | (5) | (5) | 3,243,258 | 20,448,983 |
| Ohio | 6,737,881 | 32,185,945 | 4,905,139 | 22,656,759 | 773,235 | 3,950,307 | 222,004 | 1,520,694 | 536,197 | 2,605,229 | 117,926 | 647,821 | 1,649,362 | 8,724,051 |
| Pennsylvania | 13,701,262 | 55,142,252 | 11,291,739 | 42,412,240 | 1,349,956 | 5,784,088 | 178,985 | 1,604,496 | 599,412 | 3,818,818 | 149,073 | 910,420 | 2,277,426 | 12,117,822 |
| Tennessee | 89,451 | 432,943 | 13,609 | 65,867 | | | 24,046 | 116,383 | 20,833 | 100,832 | 15,532 | 75,175 | 60,411 | 292,390 |
| Utah | 149,659 | (5) | 85,649 | (5) | | | | | 6,395 | (5) | 56,712 | (5) | 63,107 | (5) |
| Washington | 14,656 | 87,936 | 14,856 | 89,135 | | | | | 361 | 2,166 | | | 361 | 2,166 |
| West Virginia | 1,817,993 | 5,822,004 | 1,521,135 | 4,468,429 | 80,567 | 355,714 | (5) | (5) | 123,683 | 473,098 | (5) | (5) | 292,587 | 1,336,641 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 1,892,949 | 13,628,440 | 117,464 | 838,028 | 226,209 | 965,384 | 296,984 | 2,817,257 | 1,012,745 | 7,366,623 | 205,527 | 1,413,318 | 1,741,465 | 12,562,582 |
| Undistributed | | 24,631,446 | | 11,841,934 | 359,111 | 2,322,698 | 178,939 | 2,356,733 | | 8,970,768 | 295,968 | 4,408,264 | | 12,579,930 |
| Grand total, 1937 | 49,210,748 | 247,355,752 | [2] 32,229,897 | [2] 144,298,337 | [3] 5,045,628 | [3] 23,596,900 | 1,700,405 | 14,403,621 | 7,807,792 | 50,997,240 | [4] 1,596,290 | [4] 9,700,639 | 16,150,115 | 98,698,400 |
| At merchant plants | 13,076,539 | 84,334,632 | 1,853,585 | 10,277,735 | 2,226,157 | 10,714,846 | 1,374,137 | 12,096,758 | 6,247,006 | 42,248,659 | 1,105,370 | 7,043,490 | 10,952,670 | 72,103,753 |
| At furnace plants | 36,134,209 | 163,021,120 | 30,376,312 | 134,020,602 | 2,819,471 | 12,882,054 | 326,268 | 2,306,863 | 1,560,786 | 8,748,581 | 490,920 | 2,657,149 | 5,197,445 | 26,594,647 |
| Grand total, 1936 | 44,569,121 | 225,695,719 | 28,981,459 | 134,258,244 | 3,717,934 | 17,171,056 | 1,672,538 | 12,439,148 | 9,643,507 | 58,494,793 | 1,512,688 | 8,333,053 | 16,546,667 | 96,438,050 |
| Change in 1937, percent | +10.4 | +9.6 | +11.2 | +7.5 | +35.7 | +37.4 | +1.7 | +15.8 | −19.0 | −12.8 | +5.5 | +16.4 | −2.4 | +2.3 |

[1] Figures for 1938 not yet available.
[2] Includes 1,281,965 tons valued at $6,733,272 used to make producer or water gas and 529,013 tons, $2,744,853 used for other purposes than in blast furnaces.
[3] Includes 2,691,390 tons valued at $12,209,263 sold to financially affiliated corporations for blast furnace use, 734,056 tons, $4,360,297 sold for other purposes; and 1,620,182 tons, $7,027,340 reported as merchant sales.
[4] Includes 470,394 tons valued at $3,145,958 sold for manufacture of water gas.
[5] Included under "Undistributed."

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TABLE 29.—*Beehive coke produced and sold or used by producer, 1937–38, by States*

[Exclusive of screenings or breeze]

| State | Produced | | Used by producer in blast furnace [1] | | Sold | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Furnace [2] | | Foundry | | Domestic use | | Industrial and other use (including water gas) [3] | | Total | |
| | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value | Net tons | Value |
| 1937 | | | | | | | | | | | | | | |
| Colorado | 64,222 | (4) | 60,715 | (4) | | | | | | | 3,187 | (4) | 3,187 | (4) |
| Pennsylvania | 2,559,048 | $10,699,200 | 202,788 | $1,008,305 | 1,549,724 | $6,273,459 | 176,084 | $906,216 | 285,468 | $1,112,923 | 299,174 | $1,217,611 | 2,310,450 | $9,510,209 |
| Tennessee | 14,982 | 86,134 | 305 | 1,007 | 5,732 | 31,471 | 8,341 | 50,121 | | | | | 14,073 | 81,592 |
| Utah | 6,657 | (4) | | | | | | | | | 6,195 | (4) | 6,195 | (4) |
| Virginia | 240,425 | 1,180,800 | | | 80,270 | 372,126 | 49,943 | 267,454 | 703 | 3,545 | 109,440 | 538,017 | 240,356 | 1,181,142 |
| West Virginia | 279,387 | 1,232,182 | 102 | (4) | 127,562 | 525,147 | 104,049 | 505,841 | 13,555 | 49,571 | 32,854 | 143,962 | 278,020 | 1,224,521 |
| Undistributed | | 449,835 | | 387,133 | | | | | | | | 58,233 | | 58,233 |
| | 3,164,721 | 13,648,151 | [1]263,910 | [1]1,396,445 | [2]1,763,288 | [2]7,202,203 | 338,417 | 1,729,632 | 299,726 | 1,166,039 | [3]450,850 | [3]1,957,823 | 2,852,281 | 12,055,697 |
| 1938 | | | | | | | | | | | | | | |
| Colorado | 54,721 | (4) | 53,985 | (4) | | | | | | | 792 | (4) | 792 | (4) |
| Pennsylvania | 482,105 | 1,945,790 | 49,589 | 204,878 | 79,902 | 307,819 | 111,799 | 509,578 | 90,347 | 315,105 | 169,229 | 677,324 | 451,277 | 1,809,826 |
| Tennessee | 5,500 | 28,435 | | | 2,200 | (4) | 3,300 | (4) | | | | | 5,500 | 28,435 |
| Utah | 7,668 | (4) | | | | | 2,749 | (4) | 729 | (4) | 4,190 | (4) | 7,668 | (4) |
| Virginia | 133,905 | 645,630 | | | 41,351 | 181,816 | 25,661 | 134,072 | 284 | (4) | 66,690 | 328,669 | 133,986 | 645,903 |
| West Virginia | 153,513 | 675,969 | 65 | (4) | 88,049 | (4) | 21,128 | 129,937 | 1,946 | 7,920 | 43,177 | 174,538 | 154,300 | 679,588 |
| Undistributed | | 406,971 | | 354,280 | | 379,425 | | 35,443 | | 5,230 | | 30,615 | | 53,739 |
| | 837,412 | 3,702,795 | [1]103,639 | [1]559,158 | [2]211,502 | [2]869,060 | 164,637 | 809,030 | 93,306 | 328,255 | [3]284,078 | [3]1,211,146 | 753,523 | 3,217,491 |

[1] Includes coke used for other purposes than in blast furnaces as follows: 1937, 1,516 tons valued at $6,996; 1938, 786 tons, $3,346.

[2] Includes coke sold or used as follows: Financially affiliated corporations—1937, 405,661 tons valued at $1,661,596; 1938, 41,567 tons, $179,687; merchant sales—1937, 1,353,423 tons, $5,518,733; 1938, 169,777 tons, $688,504; for other purposes—1937, 4,204 tons, $21,874; 1938, 158 tons, $869.

[3] Includes coke sold for manufacture of water gas as follows: 1937, 92,039 tons valued at $369,969; 1938, 68,427 tons, $258,106.

[4] Included under "Undistributed."

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## STOCKS OF COKE AND COKING COAL

With the growth of the domestic coke trade the problem of storing coke at the producers' plants has become increasingly important, especially during the spring and summer.

On January 1, 1938, byproduct coke in stock amounted to 2,519,320 tons, of which 1,878,652 tons (75 percent,) were for domestic and general industrial use. By the end of the year total byproduct stocks had risen to 3,609,694 tons, an increase of 43 percent. Merchant plants, which supply the bulk of the domestic trade, increased their stock piles 57 percent during 1938, rising almost steadily from a low point of 786,710 tons on April 1, 1937 to a high of 2,438,396 tons on December 1, 1938. Furnace plants ordinarily carry relatively steady stocks, although during the same period they fluctuated between 467,322 and 1,460,435, ending at 1,306,719 tons. Beehive plants as a rule carry but few stocks on hand due in part to sporadic activity of the ovens during the year. At the close of 1938 there were 44,931 tons of coke in inventory, of which 29,367 tons were for domestic use.

TABLE 30.—*Stocks of furnace, foundry, and domestic coke and of breeze on January 1, 1938, by States, in net tons*

[Based on complete reports from all producers]

| State | Furnace | Foundry | Domestic and other | Total coke | Breeze |
|---|---|---|---|---|---|
| Byproduct plants: | | | | | |
| Alabama | 191,197 | 4,829 | 49,322 | 245,348 | 29,841 |
| Colorado | 1,288 | 177 | 3,828 | 5,293 | |
| Illinois | 17,591 | 63 | 129,271 | 146,925 | 43,048 |
| Indiana | 17,663 | 886 | 68,735 | 87,284 | 16,314 |
| Maryland | 46,038 | | | 46,038 | 28,085 |
| Massachusetts | 53 | | 259,320 | 259,373 | 2,973 |
| Michigan | 1,342 | 298 | 117,759 | 119,399 | 10,041 |
| Minnesota | 6,649 | | 134,058 | 140,707 | 16,264 |
| New Jersey | | | 163,864 | 163,864 | 11,937 |
| New York | [1] 10,510 | (1) | 286,270 | 296,780 | 45,807 |
| Ohio | 160,468 | 12,856 | 146,683 | 320,007 | 30,337 |
| Pennsylvania | 130,671 | 5,878 | 272,285 | 408,834 | 29,447 |
| Tennessee | 12,504 | 76 | 8,401 | 20,981 | 1,373 |
| Utah | 843 | | 659 | 1,502 | 109 |
| Washington | | | 462 | 462 | 48 |
| West Virginia | 14,398 | 4,080 | 20,450 | 38,928 | 3,270 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | [1] 310 | (1) | 217,285 | 217,595 | 8,473 |
| Total byproduct | [1] 611,525 | [1] 29,143 | 1,878,652 | 2,519,320 | 277,367 |
| At merchant plants | 16,802 | 23,002 | 1,435,027 | 1,474,831 | 129,129 |
| At furnace plants | 594,038 | 6,826 | 443,625 | 1,044,489 | 148,238 |
| Beehive plants: | | | | | |
| Colorado | | 320 | | 320 | |
| Pennsylvania | 8,760 | 10,081 | 47,995 | 66,836 | 6,186 |
| Tennessee | 1,237 | 298 | | 1,535 | |
| Utah | | | 393 | 393 | 848 |
| Virginia | 2,688 | 578 | | 3,266 | 20 |
| West Virginia | 857 | 1,987 | 773 | 3,617 | 112 |
| Total beehive | 13,542 | 13,264 | 49,161 | 75,967 | 7,166 |

[1] A small amount of foundry coke included with furnace.

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TABLE 31.—*Summary of total stocks of coke on hand at all byproduct and beehive plants on Jan. 1, 1929 and 1934–38, in net tons*

| | 1929 | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Byproduct plants: | | | | | | |
| Furnace | 750,318 | 919,583 | 922,108 | 697,699 | 282,144 | 610,840 |
| Foundry | 24,426 | 64,552 | 51,069 | 15,504 | 8,981 | 29,828 |
| Domestic and other | 1,018,205 | 1,835,743 | 2,584,481 | 2,070,544 | 1,408,350 | 1,878,652 |
| | 1,792,949 | 2,819,878 | 3,557,658 | 2,783,747 | 1,699,475 | 2,519,320 |
| Beehive plants: | | | | | | |
| Furnace | 38,446 | 5,156 | 3,133 | 2,211 | 5,622 | 13,542 |
| Foundry | 8,020 | 10,979 | 8,373 | 11,146 | 8,508 | 13,264 |
| Domestic and other | 8,511 | 29,187 | 29,379 | 32,280 | 18,461 | 49,161 |
| | 54,977 | 45,322 | 40,885 | 45,637 | 32,591 | 75,967 |
| Total: | | | | | | |
| Furnace | 788,764 | 924,739 | 925,241 | 699,910 | 287,766 | 624,382 |
| Foundry | 32,446 | 75,531 | 59,442 | 26,650 | 17,489 | 43,092 |
| Domestic and other | 1,026,716 | 1,864,930 | 2,613,860 | 2,102,824 | 1,426,811 | 1,927,813 |
| | 1,847,926 | 2,865,200 | 3,598,543 | 2,829,384 | 1,732,066 | 2,595,287 |

TABLE 32.—*Total stocks of coke at all furnace and nonfurnace byproduct plants on first of each month, 1937–38*

[Includes furnace, foundry, and domestic, but not breeze]

| Month | Furnace plants | | Other plants | | Total | |
|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 |
| January | 495,732 | 1,044,489 | 1,203,743 | 1,474,831 | 1,699,475 | 2,519,320 |
| February | 464,432 | 1,086,980 | 1,068,721 | 1,279,690 | 1,533,153 | 2,366,670 |
| March | 446,085 | 1,195,691 | 861,345 | 1,278,773 | 1,307,430 | 2,474,464 |
| April | 467,322 | 1,305,298 | 786,710 | 1,471,772 | 1,254,032 | 2,777,070 |
| May | 570,001 | 1,347,919 | 902,669 | 1,785,929 | 1,472,670 | 3,133,848 |
| June | 705,835 | 1,375,558 | 1,035,360 | 1,899,317 | 1,741,195 | 3,274,875 |
| July | 776,159 | 1,411,437 | 1,067,119 | 1,963,565 | 1,843,278 | 3,375,002 |
| August | 816,708 | 1,460,435 | 1,191,844 | 2,103,738 | 2,008,552 | 3,564,173 |
| September | 859,331 | 1,453,007 | 1,376,668 | 2,255,990 | 2,235,999 | 3,708,997 |
| October | 889,399 | 1,391,947 | 1,408,905 | 2,282,596 | 2,298,304 | 3,674,543 |
| November | 914,788 | 1,333,895 | 1,430,957 | 2,382,003 | 2,345,745 | 3,715,898 |
| December | 985,115 | 1,306,719 | 1,521,982 | 2,438,396 | 2,507,097 | 3,745,115 |

For the first time in this chapter the Bureau of Mines presents statistics showing stocks of bituminous coal for coking at byproduct coke plants.

Stocks of bituminous coal follow closely the fluctuations in the trend of monthly coke production. In 1938 a low point was reached in May, when 4,867,332 tons were on hand; the peak occurred in December, with 7,462,163 tons in stock. The low month in coke production was June and the high month December.

TABLE 33.—*Stocks of bituminous coal at byproduct coke plants at end of each month, 1935–38*

| Month | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| January | 5,014,012 | 4,640,021 | 8,030,871 | 6,469,457 |
| February | 4,989,425 | 3,844,535 | 8,687,389 | 5,822,943 |
| March | 5,680,265 | 3,431,228 | 9,638,317 | 5,231,300 |
| April | 5,656,543 | 3,514,922 | 8,543,774 | 4,934,840 |
| May | 5,591,973 | 4,064,263 | 8,187,883 | 4,867,332 |
| June | 6,446,490 | 4,565,229 | 7,770,256 | 4,999,856 |
| July | 6,607,785 | 5,302,189 | 7,432,741 | 5,364,442 |
| August | 6,950,316 | 5,982,093 | 7,455,932 | 5,539,623 |
| September | 6,803,118 | 6,562,018 | 7,760,533 | 5,951,617 |
| October | 5,985,653 | 7,295,700 | 8,066,938 | 6,459,196 |
| November | 6,129,375 | 8,146,434 | 8,114,094 | 7,172,900 |
| December | 5,559,421 | 8,535,318 | 7,273,403 | 7,462,163 |

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## VALUE AND PRICE

Reference has been made in previous chapters to the varying accounting practices of coke operators financially affiliated with iron and steel plants, by which the coke sometimes is charged to the furnace department at cost and sometimes at a price that includes a percentage of profit or at the prevailing market price.

According to trade journal quotations published currently during 1938, prices on byproduct foundry coke advanced in five markets, decreased in five other markets, and remained stationary at Buffalo, N. Y. The increases ranged from 12 cents per ton in New England to 24 cents at Philadelphia, and decreases ranged from 2 cents at Indianapolis to 24 cents at Detroit. Connellsville prices, which have until recent years been regarded as basic reference prices for the entire industry, declined 6 cents for foundry coke and 43 cents for furnace coke.

Price cutting, long-time contracts, and other factors, however, materially affect the prices at which coke operators actually dispose of coke on the open market. No data are available at this time to show the actual receipts from coke sales at byproduct plants during 1938. Beehive coke operators have, however, reported the following average values obtained for their product: Furnace coke (merchant sales) $4.06, a decrease of 2 cents per ton from 1937; foundry coke $4.91, a decrease of 20 cents; for manufacture of water gas $3.77, a decrease of 25 cents; for other industrial use $4.42, a decrease of 1 cent; and for domestic use $3.52, a decrease of 37 cents. Total value of the 873,412 tons produced, including all coke used or sold for blast-furnace purposes, was $3,702,795, an average value of $4.42 per ton. At the same time the cost of the coal consumed in beehive ovens rose to $2.05 in 1938, an increase of 4 cents per ton from 1937.

TABLE 34.—*Average receipts per net ton for coke sold in 1937, by States* [1]

| State | Byproduct | | | | Beehive | | | |
|---|---|---|---|---|---|---|---|---|
| | Furnace [2] | Foundry | Domestic | Other industrial, including water gas | Furnace [2] | Foundry | Domestic | Other industrial, including water gas |
| Alabama | $2.33 | $6.85 | $4.20 | $3.68 | | | | |
| Colorado and Utah | | 7.21 | 5.17 | 8.05 | | | | $6.21 |
| Connecticut, Massachusetts, and Rhode Island | | 7.75 | 6.68 | 7.29 | | | | |
| Illinois | 5.00 | 9.67 | 6.79 | 6.74 | | | | |
| Indiana | | 9.17 | 6.20 | (3) | | | | |
| Kentucky, Michigan, Missouri, and Wisconsin | 4.90 | 9.48 | 6.47 | 6.30 | | | | |
| Maryland and New Jersey | | (3) | 6.88 | 6.15 | | | | |
| Minnesota | | 9.39 | 9.16 | 7.66 | | | | |
| New York | 5.28 | (3) | 7.00 | (3) | | | | |
| Ohio | 5.18 | 6.85 | 4.86 | 5.49 | | | | |
| Pennsylvania | 4.20 | 8.96 | 6.37 | 6.11 | $4.04 | $5.15 | $3.90 | 4.07 |
| Tennessee | | 4.84 | 4.84 | 4.84 | 5.49 | 6.01 | | |
| Virginia | | | | | 4.64 | 5.36 | 5.04 | 4.92 |
| Washington | | | 6.00 | | | | | |
| West Virginia | 4.33 | (3) | 3.83 | 3.95 | 4.12 | 4.86 | 3.66 | 4.38 |
| Undistributed | | 9.15 | | 6.64 | | | | |
| Average | 4.46 | 8.47 | 6.53 | 6.08 | 4.08 | 5.11 | 3.89 | 4.34 |
| At merchant plants | 4.28 | 8.80 | 6.76 | 6.37 | (4) | (4) | (4) | (4) |
| At furnace plants | 4.56 | 7.07 | 5.61 | 5.41 | (4) | (4) | (4) | (4) |

[1] Figures for 1938 not yet available.
[2] Includes coke sold to affiliated corporations and merchant sales.
[3] Included under "Undistributed."
[4] Not available.

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TABLE 35.—*Average monthly prices pet net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1935–38* [1]

| Month | Furnace coke | | | | | Foundry coke | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1929 | 1935 | 1936 | 1937 | 1938 | 1929 | 1935 | 1936 | 1937 | 1938 |
| January | $2.75 | $3.85 | $3.65 | $4.00 | $4.00 | $3.75 | $4.60 | $4.25 | $4.50 | $5.00 |
| February | 2.90 | 3.85 | 3.65 | 4.06 | 4.00 | 3.75 | 4.60 | 4.25 | 4.50 | 5.00 |
| March | 2.98 | 3.85 | 3.65 | 4.25 | 4.00 | 3.75 | 4.60 | 4.25 | 4.50 | 5.00 |
| April | 2.78 | 3.85 | 3.65 | 4.51 | 4.00 | 3.75 | 4.60 | 4.25 | 5.00 | 5.00 |
| May | 2.75 | 3.85 | 3.65 | 4.60 | 4.00 | 3.75 | 4.60 | 4.25 | 5.25 | 5.00 |
| June | 2.75 | 3.59 | 3.65 | 4.58 | 3.85 | 3.75 | 4.15 | 4.25 | 5.25 | 4.85 |
| July | 2.75 | 3.27 | 3.50 | 4.35 | 3.75 | 3.75 | 3.88 | 4.00 | 5.00 | 4.75 |
| August | 2.73 | 3.29 | 3.61 | 4.35 | 3.75 | 3.75 | 4.00 | 4.00 | 5.00 | 4.75 |
| September | 2.65 | 3.25 | 3.69 | 4.27 | 3.75 | 3.75 | 4.00 | 4.05 | 5.00 | 4.75 |
| October | 2.65 | 3.53 | 3.75 | 4.25 | 3.75 | 3.75 | 4.20 | 4.25 | 5.00 | 4.75 |
| November | 2.65 | 3.60 | 3.75 | 4.25 | 3.75 | 3.75 | 4.25 | 4.25 | 5.00 | 4.75 |
| December | 2.64 | 3.57 | 3.92 | 4.00 | 3.75 | 3.75 | 4.15 | 4.40 | 5.00 | 4.75 |
| Average | 2.75 | 3.61 | 3.68 | 4.29 | 3.86 | 3.75 | 4.30 | 4.20 | 4.92 | 4.86 |

[1] Iron Age.

TABLE 36.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets, 1934–38, as quoted by Steel*

| | January | February | March | April | May | June | July | August | September | October | November | December | Average for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Birmingham, Ala. (at ovens): | | | | | | | | | | | | | |
| 1934 | $5.00 | $5.00 | $5.00 | $5.40 | $5.50 | $5.70 | $6.00 | $6.00 | $6.00 | $6.00 | $6.00 | $6.00 | $5.63 |
| 1935 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| 1936 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 |
| 1937 | 6.50 | 6.50 | 6.50 | 6.95 | 7.25 | 7.25 | 7.25 | 7.25 | 7.30 | 7.50 | 7.50 | 7.50 | 7.10 |
| 1938 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.25 |
| Buffalo, N. Y. (delivered at consumers' works): [1] | | | | | | | | | | | | | |
| 1934 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| 1935 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| 1936 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 9.15 | 10.50 | 10.50 | 8.14 |
| 1937 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 |
| 1938 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 |
| Chicago, Ill. (at ovens): | | | | | | | | | | | | | |
| 1934 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |
| 1935 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 9.00 | 9.00 | 9.00 | 8.63 |
| 1936 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 |
| 1937 | 9.50 | 9.50 | 9.50 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.06 |
| 1938 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.10 | 9.75 | 9.75 | 9.75 | 9.75 | 9.75 | 10.03 |
| Cincinnati, Ohio (delivered at consumers' works): | | | | | | | | | | | | | |
| 1934 | (2) | (2) | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 |
| 1935 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.30 | 9.15 | 9.00 | 9.50 | 9.50 | 9.50 | 9.31 |
| 1936 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 |
| 1937 | 9.70 | 9.75 | 9.75 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.31 |
| 1938 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 9.90 | 9.75 | 9.75 | 9.75 | 9.75 | 9.75 | 10.14 |
| Cleveland, Ohio (delivered at consumers' works): | | | | | | | | | | | | | |
| 1934 | (2) | (2) | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 |
| 1935 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.75 | 9.75 | 9.75 | 9.38 |
| 1936 | 9.75 | 9.75 | 9.75 | 9.75 | 9.75 | 9.75 | 9.75 | 9.75 | 9.75 | 9.90 | 10.30 | 10.30 | 9.85 |
| 1937 | 10.30 | 10.30 | 10.30 | 10.80 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.05 | 10.81 |
| 1938 | 11.05 | 11.05 | 11.05 | 11.05 | 11.05 | 11.05 | 10.75 | 10.30 | 10.30 | 10.30 | 10.30 | 10.30 | 10.71 |
| Detroit, Mich. (delivered at consumers' works): [1] | | | | | | | | | | | | | |
| 1934 | 8.00 | 8.00 | 8.15 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.39 |
| 1935 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.90 | 9.00 | 9.00 | 8.62 |
| 1936 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.64 | 10.70 | 10.70 | 9.34 |
| 1937 | 10.50 | 10.70 | 10.70 | 10.89 | 11.10 | 11.10 | 11.10 | 11.10 | 11.10 | 11.10 | 11.10 | 11.10 | 10.97 |
| 1938 | 11.10 | 11.10 | 11.10 | 11.10 | 11.10 | 11.10 | 10.90 | 10.25 | 10.25 | 10.25 | 10.25 | 10.25 | 10.73 |
| Indianapolis, Ind. (delivered at consumers' works): | | | | | | | | | | | | | |
| 1934 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 |
| 1935 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 9.15 | 9.40 | 9.40 | 8.89 |
| 1936 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 | 9.40 |
| 1937 | 9.60 | 9.65 | 9.65 | 10.33 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.27 |
| 1938 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.25 |

[1] Up to Oct. 26, 1936, quotations are "at ovens." [2] Not quoted until March.

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TABLE 36.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets, 1934–38, as quoted by Steel*—Continued

| | January | February | March | April | May | June | July | August | September | October | November | December | Average for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Newark, N. J. (delivered at consumers' works): | | | | | | | | | | | | | |
| 1934 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 | 8.71 |
| 1935 | 8.83 | 9.20 | 9.20 | 9.20 | 9.20 | 9.20 | 9.20 | 9.20 | 9.20 | 9.20 | 9.20 | 9.20 | 9.17 |
| 1936 | 9.60 | 9.70 | 9.70 | 9.70 | 9.70 | 9.70 | 9.70 | 9.70 | 9.70 | 10.20 | 10.20 | 10.20 | 9.82 |
| 1937 | 10.17 | 10.17 | 10.17 | 10.85 | 10.85 | 10.85 | 10.85 | 10.85 | 10.85 | 10.85 | 10.85 | 10.88 | 10.68 |
| 1938 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 | 10.88 |
| New England (delivered at consumers' works): | | | | | | | | | | | | | |
| 1934 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.87 | 11.00 | 10.57 |
| 1935 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.40 | 11.50 | 11.50 | 11.12 |
| 1936 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.70 | 12.00 | 12.00 | 11.60 |
| 1937 | 12.00 | 12.00 | 12.00 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.38 |
| 1938 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 |
| Philadelphia, Pa. (delivered at consumers' works): | | | | | | | | | | | | | |
| 1934 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 |
| 1935 | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 | 9.03 | 9.03 | 9.03 | 9.03 | 9.03 | 9.03 | 9.03 | 9.02 |
| 1936 | 9.38 | 9.38 | 9.38 | 9.38 | 9.38 | 9.38 | 9.38 | 9.38 | 9.38 | 9.88 | 9.88 | 9.88 | 9.50 |
| 1937 | 9.85 | 9.85 | 9.85 | 10.40 | 10.60 | 10.60 | 10.60 | 10.60 | 10.60 | 10.60 | 10.60 | 10.60 | 10.40 |
| 1938 | 10.62 | 10.63 | 10.63 | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 10.64 |
| St. Louis, Mo. (delivered at consumers' works): | | | | | | | | | | | | | |
| 1934 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 |
| 1935 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 9.80 | 10.00 | 10.00 | 9.42 |
| 1936 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| 1937 | 10.10 | 10.50 | 10.50 | 10.80 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 10.83 |
| 1938 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 |

## SHIPMENTS BY RAIL

TABLE 37.—*Beehive coke loaded for shipment on originating railroads in the United States, 1937–38, by routes, as reported by coke producers*

| Route | State | Net tons | | Percent of total |
|---|---|---|---|---|
| | | By States | Total | |
| 1937 | | | | |
| Railroads: | | | | |
| Baltimore & Ohio | Pennsylvania | 419,224 | 459,825 | 15.1 |
| | West Virginia | 40,601 | | |
| Chesapeake & Ohio | do | 40,335 | 40,335 | 1.3 |
| Denver & Rio Grande Western | Colorado | 63,902 | 71,866 | 2.4 |
| | Utah | 7,964 | | |
| Interstate | Virginia | 211,249 | 211,249 | 6.9 |
| Ligonier Valley | Pennsylvania | 47,312 | 47,312 | 1.5 |
| Louisville & Nashville | Virginia | 3,120 | 3,120 | .1 |
| Monongahela | Pennsylvania | 891,154 | 891,154 | 29.3 |
| Nashville, Chattanooga & St. Louis | Tennessee | 14,073 | 14,073 | .5 |
| New York Central | West Virginia | 196,837 | 196,837 | 6.5 |
| Norfolk & Western | Virginia | 32,190 | 32,190 | 1.1 |
| Pennsylvania | Pennsylvania | 1,076,835 | 1,076,835 | 35.3 |
| Pittsburgh & Lake Erie | do | 1,000 | 1,000 | (1) |
| Total railroad shipments | | 3,045,796 | 3,045,796 | 100.0 |
| 1938 | | | | |
| Railroads: | | | | |
| Baltimore & Ohio | Pennsylvania | 72,913 | 76,964 | 8.7 |
| | West Virginia | 4,051 | | |
| Chesapeake & Ohio | do | 24,034 | 24,034 | 2.7 |
| Denver & Rio Grande Western | Colorado | 54,777 | 66,765 | 7.5 |
| | Utah | 11,988 | | |
| Interstate | Virginia | 119,056 | 119,056 | 13.4 |
| Ligonier Valley | Pennsylvania | 7,864 | 7,864 | .9 |
| Louisville & Nashville | Virginia | 500 | 500 | .1 |
| Monongahela | Pennsylvania | 188,678 | 188,678 | 21.3 |
| Nashville, Chattanooga & St. Louis | Tennessee | 5,500 | 5,500 | .6 |
| New York Central | West Virginia | 126,215 | 126,215 | 14.2 |
| Norfolk & Western | Virginia | 20,243 | 20,243 | 2.3 |
| Pennsylvania | Pennsylvania | 250,027 | 250,027 | 28.2 |
| Pittsburgh & Lake Erie | do | 1,381 | 1,381 | .1 |
| Total railroad shipments | | 887,227 | 887,227 | 100.0 |

[1] Less than 0.1 percent.

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## EXPORTS AND IMPORTS[2]

Exports of coke from the United States totaled 486,571 tons valued at $3,035,105 in 1938, a decrease of 40,112 tons from the 1937 total of 526,683 tons. It is worthy of note that while United States production declined 38 percent, exports to foreign countries dropped less than 8 percent. As usual, the principal export movement was to Canada, which received 461,310 tons (95 percent of the total) the bulk going through the gateways of Buffalo and Michigan. Outside of Canada the export market for American coke is small, although 6,013 tons were shipped to France and 5,880 tons to Switzerland in 1938.

Imports of coke supply an insignificant part of the requirements of the country and are a factor in the home market only in restricted localities. In 1938, 135,240 tons were received in the United States, supplied by only four countries—Canada, Belgium, Germany, and the United Kingdom—in order of importance.

TABLE 38.—*Coke*[1] *exported from the United States, 1936–38, by customs districts*

| District | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Net tons | Value | Net tons | Value | Net tons | Value |
| Buffalo | 302,006 | $1,906,366 | 220,448 | $1,406,897 | 222,484 | $1,431,715 |
| Chicago | 33,463 | 171,006 | 11,535 | 84,472 | 22,813 | 100,381 |
| Dakota | 11,794 | 86,297 | 10,120 | 77,714 | 7,254 | 57,958 |
| Duluth-Superior | 3,711 | 27,879 | 3,697 | 32,144 | 3,214 | 27,745 |
| Florida | 3,472 | 21,058 | 3,750 | 76,125 | 4 | 53 |
| Galveston | 31 | 341 | | | 2,199 | 10,995 |
| Maine and New Hampshire | 436 | 3,432 | 859 | 7,297 | 94 | 831 |
| Maryland | 968 | 5,481 | 3,829 | 20,989 | 1,992 | 13,025 |
| Michigan | 246,103 | 1,508,978 | 221,763 | 1,459,913 | 169,292 | 975,592 |
| Mobile | 1,716 | 7,721 | 13,847 | 100,470 | 7,127 | 109,810 |
| New Orleans | 4,257 | 49,773 | 3,092 | 35,152 | 2,461 | 21,244 |
| New York | 1,030 | 11,756 | 4,623 | 70,082 | 12,517 | 89,905 |
| Ohio | 31,787 | 185,176 | 12,051 | 72,877 | 20,974 | 110,857 |
| Philadelphia | 7,251 | 68,517 | 12,597 | 80,358 | 11,255 | 51,770 |
| Rochester | | | 1,107 | 6,364 | 40 | 394 |
| St. Lawrence | 5,516 | 41,601 | 2,257 | 25,200 | 1,440 | 16,590 |
| San Diego | 540 | 6,067 | 129 | 2,005 | 252 | 4,176 |
| Virginia | 237 | 1,849 | 364 | 3,651 | 567 | 5,266 |
| Wisconsin | 15,027 | 80,271 | | | | |
| Other[2] | 967 | 7,566 | 615 | 6,118 | 592 | 6,798 |
| | 670,312 | 4,191,135 | 526,683 | 3,567,828 | 486,571 | 3,035,105 |

[1] Includes coal and coke briquets prior to 1937.
[2] Includes values under $5,000.

[1] Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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TABLE 39.—*Coke* [1] *exported from the United States, 1936–38, by countries*

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Net tons | Value | Net tons | Value | Net tons | Value |
| North America: | | | | | | |
| Canada | 650,036 | $4,013,243 | 488,880 | $3,185,966 | 461,310 | $2,760,529 |
| Central America: Panama | 519 | 7,069 | 153 | 3,693 | 100 | 1,162 |
| Mexico | 1,365 | 12,555 | 488 | 4,706 | 790 | 10,287 |
| West Indies: | | | | | | |
| Cuba | 2,257 | 10,597 | 14,854 | 81,347 | 2,168 | 17,299 |
| Trinidad and Tobago | 2 | 23 | 3,198 | 27,483 | 213 | 2,223 |
| Other | 418 | 6,246 | 390 | 6,568 | 353 | 4,729 |
| South America: | | | | | | |
| Bolivia | 802 | 5,966 | | | 445 | 6,638 |
| Chile | 918 | 5,896 | 3,818 | 20,833 | 1,750 | 9,679 |
| Other | 46 | 699 | 115 | 4,238 | 494 | 5,672 |
| Europe: | | | | | | |
| France | 4,359 | 36,546 | 605 | 7,441 | 6,013 | 53,108 |
| Germany | | | | | 1,417 | 10,628 |
| Italy | 3,125 | 42,933 | 9,156 | 156,196 | 2,760 | 40,861 |
| Netherlands | 487 | 4,282 | 1,247 | 10,006 | | |
| Norway | 2,253 | 20,745 | 564 | 10,080 | 2,199 | 10,995 |
| Switzerland | | | 2,800 | 42,090 | 5,880 | 90,703 |
| United Kingdom | 3,639 | 23,402 | 336 | 5,866 | 679 | 10,592 |
| Asia | 17 | 300 | 79 | 1,315 | | |
| Africa: Liberia | 1 | 25 | | | | |
| Oceania | 68 | 608 | | | | |
| | 670,312 | 4,191,135 | 526,683 | 3,567,828 | 486,571 | 3,035,105 |

[1] Includes coal and coke briquets prior to 1937.

TABLE 40.—*Coke imported for consumption in the United States, 1936–38, by customs districts*

| District | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Net tons | Value | Net tons | Value | Net tons | Value |
| Buffalo | 30,523 | $463,694 | 42,827 | $650,182 | 24,527 | $496,159 |
| Dakota | 2 | 26 | (1) | 5 | | |
| Hawaii | 317 | 2,295 | 556 | 7,528 | 726 | 6,436 |
| Los Angeles | 38,100 | 133,945 | 40,826 | 183,274 | 23,752 | 130,187 |
| Maine and New Hampshire | 233 | 1,654 | 390 | 1,506 | 252 | 1,866 |
| Massachusetts | 74,165 | 286,291 | 37,738 | 169,021 | 19,852 | 76,212 |
| Michigan | 1,027 | 15,811 | 27 | 207 | | |
| Montana and Idaho | 18,911 | 97,800 | 28,833 | 157,051 | 28,902 | 162,154 |
| New York | 120,225 | 464,796 | 76,489 | 315,443 | 6,983 | 32,683 |
| Oregon | 2,683 | 10,537 | 3,340 | 11,528 | 2,259 | 14,085 |
| Rhode Island | 8,360 | 34,722 | 4,749 | 28,808 | 1,120 | 6,005 |
| St. Lawrence | 697 | 4,516 | 1,628 | 10,424 | 61 | 446 |
| San Antonio | 517 | 2,309 | | | | |
| San Francisco | 24,011 | 78,578 | 30,701 | 144,037 | 19,983 | 125,245 |
| Vermont | 143 | 1,018 | 360 | 2,690 | 260 | 1,910 |
| Washington | 10,045 | 37,509 | 17,900 | 97,798 | 6,563 | 40,758 |
| | 329,959 | 1,635,501 | 286,364 | 1,779,502 | 135,240 | 1,094,146 |

[1] Less than 1 ton.

TABLE 41.—*Coke imported for consumption in the United States, 1936–38, by countries*

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Net tons | Value | Net tons | Value | Net tons | Value |
| Belgium | 158,920 | $606,181 | 91,698 | $401,516 | 35,772 | $165,724 |
| Canada | 52,730 | 590,702 | 83,033 | 882,061 | 58,065 | 691,611 |
| Germany | 31,750 | 78,554 | 57,322 | 239,457 | 21,907 | 108,327 |
| Mexico | 516 | 2,309 | | | | |
| Netherlands | 27,795 | 115,194 | 20,517 | 90,063 | | |
| Poland and Danzig | 3,818 | 13,837 | | | | |
| United Kingdom | 54,430 | 228,724 | 33,794 | 166,405 | 19,496 | 128,484 |
| | 329,959 | 1,635,501 | 286,364 | 1,779,502 | 135,240 | 1,094,146 |

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## WORLD PRODUCTION

Although data on world production of coke in 1938 are incomplete, figures are available to show the output of most of the principal producing countries. For the first time since 1921 the United States relinquished its position as the leading coke producer of the world. Germany led in 1938 with an output of 43,510,956 metric tons, followed by the United States, U. S. S. R., and Great Britain in the order named. World production of coke gained 22 percent in the decade 1928–37, most of the expansion occurring in U. S. S. R., which increased its production nearly fourfold during this period.

TABLE 42.—*Coke produced in principal countries, 1929 and 1935–38, in metric tons* [1]

[Compiled by M. T. Latus]

| Country | 1929 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Australia: | | | | | |
| New South Wales | 471,813 | 871,644 | 907,537 | 955,030 | (2) |
| Queensland | 4,144 | 25,276 | 23,701 | 30,949 | 31,474 |
| Belgium | 6,192,960 | 4,915,860 | 5,252,360 | 6,083,910 | 4,703,120 |
| Bulgaria | | 1,705 | 1,683 | 4,550 | 3,923 |
| Canada | 1,986,532 | 1,663,515 | 1,830,101 | 1,984,581 | 1,810,358 |
| China (exports) | 13,467 | 7,246 | 11,422 | 9,062 | 11,630 |
| Chosen | (2) | 201,840 | (2) | (2) | (2) |
| Czechoslovakia | 3,170,629 | 1,553,869 | 1,955,515 | 3,279,864 | (2) |
| France | 9,080,127 | 7,083,170 | 7,101,380 | 7,900,000 | (2) |
| Germany | 39,421,033 | 29,801,234 | 35,832,617 | 40,896,343 | 43,510,956 |
| Saar | 2,423,000 | (4) | (4) | (4) | (4) |
| Great Britain [5] | 13,637,421 | 12,131,081 | 13,972,181 | 15,171,482 | 13,031,349 |
| Hungary | 2,092 | 22,981 | 24,133 | 35,092 | (2) |
| India, British [6] | 843,504 | 1,795,178 | 1,840,362 | 1,896,816 | (2) |
| Indochina | 637 | 260 | 109 | 128 | 3,503 |
| Italy | 791,607 | 998,379 | 1,210,714 | 1,693,024 | (2) |
| Japan: | | | | | |
| Manufactured coke | (2) | 1,833,492 | (2) | (2) | (2) |
| Natural coke | (2) | 396,214 | (2) | (2) | (2) |
| Mexico | 493,777 | 489,047 | (2) | (2) | (2) |
| Netherlands | 2,402,566 | 2,878,191 | 3,053,451 | 3,364,885 | 2,395,422 |
| New Caledonia | | | | | 43,317 |
| Peru | 35,899 | (2) | (2) | 3,607 | (2) |
| Poland | 1,858,052 | 1,386,716 | 1,615,598 | 2,125,519 | 2,523,290 |
| Rhodesia, Southern | 100,001 | 39,239 | 20,115 | 56,029 | (2) |
| Rumania | | 45,920 | 63,214 | 77,828 | (2) |
| Spain | 768,040 | (2) | (2) | (2) | (2) |
| Straits Settlements | 15,667 | 9,324 | 9,619 | 10,134 | 10,400 |
| Sweden | 103,778 | 115,430 | 112,497 | 121,630 | 105,700 |
| Turkey | | 33,653 | 37,411 | 74,792 | (2) |
| Union of South Africa | 99,297 | 64,782 | 75,459 | 109,133 | 163,315 |
| U. S. S. R. | 4,700,000 | 16,730,000 | 19,883,000 | 20,000,000 | 20,700,000 |
| United States | 54,325,427 | 31,879,449 | 41,979,921 | 47,513,978 | 29,604,281 |
| | 144,481,000 | 117,505,000 | 140,344,000 | 156,998,000 | (2) |

[1] Gas-house coke is not included.
[2] Data not available.
[3] Estimate included in total.
[4] Beginning with March 1935 production of the Saar is included with that of Germany.
[5] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1935, 12,175,443 tons; 1936, 12,935,933 tons; 1937, 13,150,928 tons.
[6] Figures for 1929 represent "hard" and "soft" coke made at collieries only (73,616 tons of "hard" coke and 769,888 tons of "soft" coke). Data for other years shown represent total "hard" coke manufactured. In addition, the following quantities of "soft" coke were made at collieries: 1935, 904,840 tons; 1936, 932,534 tons; 1937, 850,581 tons.

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## COKE-OVEN BYPRODUCTS

The statistics in the following tables are confined to the major products obtained in high-temperature byproduct ovens. These products fall into five general groups, some of which are further subdivided. They are (1) gas, by far the most valuable byproduct, followed by (2) light oil and derivatives, (3) tar, (4) ammonia, and (5) miscellaneous products. In recent years an increasing number of operators have installed equipment at their plants for making tar derivatives on the premises. The sales value of such derivatives during 1937 amounted to $2,944,439, including phenol and sodium phenolate (except for phenol and tar acids produced at Clairton, Pa.), and the tar that went into the distilling of these products totaled 88,588,133 gallons, reported from eight plants. Total sales value of all byproducts in 1937 was $132,124,838, more than half the value of the coke production. If to this amount is added a value for the tar used by the producer ($10,490,075), and the value of the breeze production ($7,954,608), the ratio of the value of byproducts to the value of coke produced becomes about 3 to 5.

Complete statistics are not available at this time covering production and sales of byproducts during 1938; however, monthly reports received currently from coke operators throughout 1938 indicate a production of 873,405,000 pounds of ammonium sulfate and 44,025,000 pounds of ammonia liquor ($NH_3$ content), decreases of 32 and 19 percent, respectively, from 1937. The bulk of the ammonium sulfate is recovered at furnace plants, where coke production decreased 43 percent, while ammonia liquor is produced mainly at merchant plants, where the coke output dropped 15 percent. Benzol output (crude and refined plus motor benzol), as reported currently during 1938, amounted to 71,362,000 gallons, a loss of 39 percent from the 1937 total of 117,187,217 gallons. According to trade-journal reports the 1938 average price asked for sulfate of ammonia was $1.43 for 100 pounds, f. o. b. oven or port, an increase of 3 cents compared with the $1.40 price asked in 1937. Prices for benzol, from the same source, remained constant at $0.16 per gallon in tank lots.

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TABLE 43.—*Byproducts obtained from coke-oven operations in the United States in 1937* [1]

[Exclusive of screenings or breeze]

| Product | Production | Sales | | |
|---|---|---|---|---|
| | | Quantity | Value | |
| | | | Total | Average |
| Tar—gallons | 603,053,288 | 386,648,478 | $18,456,483 | $0.048 |
| Ammonia: | | | | |
| Sulfate—pounds | 1,289,740,739 | 1,332,308,748 | 14,477,234 | .011 |
| Ammonia liquor ($NH_3$ content)—do | 54,172,628 | 52,394,717 | 1,571,091 | .030 |
| Sulfate equivalent of all forms—do | | | 16,048,325 | |
| | 1,506,431,251 | 1,541,887,616 | | |
| Gas: | | | | |
| Used under boilers, etc.—M cubic feet | [2] 757,628,942 | 32,776,758 | 1,969,693 | .060 |
| Used in steel or affiliated plants—do | | 251,571,649 | 25,419,223 | .101 |
| Distributed through city mains—do | | 150,936,668 | 42,657,825 | .283 |
| Sold for industrial use—do | | 27,757,884 | 2,914,956 | .105 |
| | | 463,042,959 | 72,961,697 | .158 |
| Light oil and derivatives: | | | | |
| Crude light oil—gallons | [3] 187,054,346 | 11,113,150 | 955,459 | .086 |
| Benzol, crude and refined—do | 21,660,522 | 22,140,936 | 2,928,471 | .132 |
| Motor benzol—do | 95,526,695 | 93,767,208 | 8,384,863 | .089 |
| Toluol, crude and refined—do | 20,896,724 | 20,173,723 | 5,350,087 | .265 |
| Solvent naphtha—do | 5,725,918 | 5,255,014 | 988,411 | .188 |
| Xylol—do | 4,562,344 | 4,245,316 | 1,176,723 | .277 |
| Other light-oil products—do | 8,130,103 | 5,522,858 | 431,390 | .078 |
| | [4] 156,502,306 | 162,218,205 | 20,215,404 | .125 |
| Naphthalene, crude and refined—pounds | 60,797,108 | 60,315,581 | 1,182,992 | .020 |
| Tar derivatives: | | | | |
| Creosote oil, distillate as such—gallons | 15,401,597 | 14,900,402 | 1,452,879 | .098 |
| Creosote oil in coal-tar solution—do | 1,908,550 | 1,048,044 | 89,223 | .085 |
| Pitch of tar—net tons | 236,312 | 4,314 | 36,848 | 8.541 |
| Other tar derivatives | | | 1,310,612 | |
| Phenol—gallons | 104,738 | 110,181 | 43,272 | .393 |
| Sodium phenolate—do | 154,112 | 147,545 | 11,605 | .079 |
| Other products [5] | | | 315,498 | |
| Value of all byproducts sold | | | [6] 132,124,838 | |

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name, except, however, phenol and other tar acids produced at Clairton, Pa.; figures for 1938 not yet available.
[2] Includes gas wasted and gas used for heating retorts.
[3] Refined on the premises to make the derived products shown, 182,030,795 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, asphalt paint, carbolates, crude ferrocyanide, cyanogen sludge, extide covering, insecticides, light carbolic oils, pyridine oil, sodium carbolate, sodium prussiate, spent soda solution, sulfur (brimstone), and vented vapors.
[6] Exclusive of the value of breeze production, which amounted to $7,954,608.

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TABLE 44.—*Coal equivalent of byproducts of byproduct coking, 1913, 1914, 1918, and 1936–37* [1]

| Year | Quantity of byproducts | | | | Rough equivalent in heating value (billion B. t. u.) | | | | | Coal equivalent | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | Coke breeze (thousand net tons) | Surplus gas (billion cubic feet) | Tar produced (thousand gallons) | Light oil produced (thousand gallons) | Coke breeze (1×20) | Surplus gas (2×550) | Tar (3×0.150) | Light oil (4×0.130) | Total (5+6+7+8) | Net tons (9÷0.0262) | Percent this forms of coal made into coke |
| 1913 | 735 | 64 | 115,145 | 3,000 | 14,700 | 35,200 | 17,272 | 390 | 67,562 | 2,600,000 | 3.8 |
| 1914 | 667 | 61 | 109,901 | 8,464 | 13,340 | 33,550 | 16,485 | 1,100 | 64,475 | 2,461,000 | 4.8 |
| 1918 | 1,999 | 158 | 263,299 | 87,562 | 39,980 | 86,900 | 39,495 | 11,383 | 177,758 | 6,785,000 | 8.0 |
| 1936 | 3,577 | 434 | 560,386 | 170,234 | 71,540 | 238,700 | 84,058 | 22,130 | 416,428 | 15,894,000 | 24.1 |
| 1937 | 3,884 | 463 | 603,053 | 187,054 | 77,680 | 254,650 | 90,458 | 24,317 | 447,105 | 17,065,000 | 22.9 |

[1] Figures for 1938 not yet available.

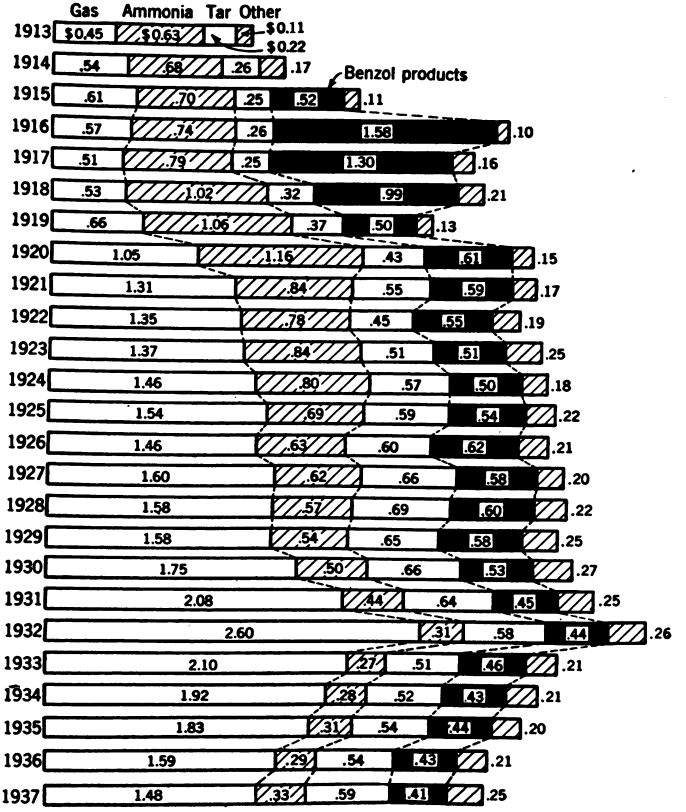


FIGURE 3.—Gross value of the several byproducts per ton of byproduct coke produced, 1913–37.

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## COKE-OVEN GAS

TABLE 45.—*Coke-oven gas produced and sold in the United States in 1937, by States* [1]

| State | Active plants | Produced (M cubic feet) | Used in heating ovens (M cubic feet) | Surplus sold or used | | | Wasted (M cubic feet) |
|---|---|---|---|---|---|---|---|
| | | | | M cubic feet | Value | | |
| | | | | | Total | Average | |
| Alabama | 7 | 65,441,380 | 28,532,219 | 33,232,889 | $2,393,212 | $0.072 | 3,676,272 |
| Colorado | 1 | 8,615,186 | 4,055,442 | 4,463,932 | (2) | (2) | 95,812 |
| Illinois | 8 | 43,241,620 | 13,615,167 | 27,866,444 | 5,001,230 | .179 | 1,760,009 |
| Indiana | 6 | 81,623,621 | 33,906,586 | 46,281,736 | 7,365,936 | .159 | 1,345,299 |
| Maryland | 1 | 19,502,322 | 8,562,127 | 10,940,195 | (2) | (2) | |
| Massachusetts | 2 | 18,262,596 | 5,817,048 | 12,396,634 | (2) | (2) | 48,914 |
| Michigan | 8 | 37,576,334 | 13,401,137 | 24,152,942 | 3,293,338 | .136 | 22,255 |
| Minnesota | 3 | 11,336,546 | 4,808,208 | 6,443,393 | 1,646,201 | .255 | 84,945 |
| New Jersey | 2 | 16,727,254 | 3,746,432 | 12,980,822 | (2) | (2) | |
| New York | 8 | 74,109,497 | 18,772,989 | 53,716,629 | 15,590,334 | .290 | 1,619,879 |
| Ohio | 14 | 98,205,869 | 42,120,697 | 54,135,781 | 5,994,264 | .111 | 1,949,391 |
| Pennsylvania | 12 | 221,351,285 | 86,843,114 | 131,803,433 | 14,989,921 | .114 | 2,704,738 |
| Tennessee | 1 | 1,222,221 | 549,990 | 672,231 | 167,636 | .249 | |
| Utah | 1 | 3,506,484 | 1,607,415 | 1,645,645 | (2) | (2) | 253,424 |
| Washington | 1 | 294,893 | | 266,377 | 96,518 | .362 | 28,516 |
| West Virginia | 4 | 27,869,082 | 8,917,819 | 18,935,138 | 1,614,587 | .085 | 16,125 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 6 | 28,742,752 | 5,288,280 | 23,108,738 | 6,869,932 | .297 | 345,734 |
| Undistributed | | | | | 7,938,588 | .187 | |
| Grand total, 1937 | 85 | 757,628,942 | 280,634,670 | 463,042,959 | 72,961,697 | .158 | 13,951,313 |
| At merchant plants | 42 | 199,595,970 | 50,812,233 | 145,111,921 | 37,545,461 | .259 | 3,671,816 |
| At furnace plants | 43 | 558,032,972 | 229,822,437 | 317,931,038 | 35,416,236 | .111 | 10,279,497 |
| Grand total, 1936 | 85 | 699,701,415 | 254,125,915 | 433,639,041 | 70,830,970 | .163 | 11,936,459 |
| Change in 1937, percent | | +8.3 | +10.4 | +6.8 | +3.0 | −3.1 | +16.9 |

[1] Figures for 1938 not yet available. [2] Included under "Undistributed."

TABLE 46.—*Disposition of surplus coke-oven gas in the United States in 1937, by States* [1]

| State | Used by producer | | | | | |
|---|---|---|---|---|---|---|
| | Under boilers | | | In steel or other affiliated plants | | |
| | M cubic feet | Value | | M cubic feet | Value | |
| | | Total | Average | | Total | Average |
| Alabama | 9,653,158 | $484,338 | $0.050 | 17,303,254 | $1,164,838 | $0.067 |
| Colorado | | | | 4,463,932 | (2) | (2) |
| Illinois | 2,790,802 | 243,768 | .087 | 4,573,953 | 665,157 | .145 |
| Indiana | 449,850 | 27,969 | .062 | 37,344,041 | 4,901,093 | .131 |
| Maryland | | | | 4,766,140 | (2) | (2) |
| Massachusetts | 192,679 | (2) | (2) | | | |
| Michigan | 1,724,282 | 86,214 | .050 | 12,447,720 | 1,998,886 | .161 |
| Minnesota | 412,629 | 23,535 | .057 | 1,918,685 | 233,120 | .121 |
| New Jersey | 805 | (2) | (2) | | | |
| New York | 2,552,498 | 153,650 | .060 | 14,905,212 | 1,626,293 | .109 |
| Ohio | 3,506,494 | 338,203 | .096 | 39,731,888 | 3,791,352 | .095 |
| Pennsylvania | 9,907,717 | 498,413 | .050 | 97,326,768 | 8,694,530 | .089 |
| Tennessee | 172,020 | 6,021 | .035 | | | |
| Utah | 964,194 | (2) | (2) | 23,092 | (2) | (2) |
| Washington | 1,445 | 72 | .050 | | | |
| West Virginia | 98,045 | 6,201 | .063 | 16,766,964 | 1,273,868 | .076 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 350,140 | 35,456 | .101 | | | |
| Undistributed | | 65,853 | .057 | | 1,070,086 | .116 |
| Grand total, 1937 | 32,776,758 | 1,909,693 | .060 | 251,571,649 | 25,419,223 | .101 |
| At merchant plants | 10,110,538 | 709,571 | .070 | 5,517,065 | 435,626 | .079 |
| At furnace plants | 22,666,220 | 1,260,122 | .056 | 246,054,584 | 24,983,597 | .102 |
| Grand total, 1936 | 28,807,618 | 1,764,469 | .061 | 226,229,045 | 21,717,052 | .096 |
| Change in 1937, percent | +13.8 | +11.6 | −1.6 | +11.2 | +17.0 | +5.2 |

[1] Figures for 1938 not yet available. [2] Included under "Undistributed."

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TABLE 46.—*Disposition of surplus coke-oven gas in the United States in 1937, by States* —Continued

| State | Sold | | | | | |
|---|---|---|---|---|---|---|
| | Distributed through city mains | | | Sold for industrial purposes | | |
| | M cubic feet | Value | | M cubic feet | Value | |
| | | Total | Average | | Total | Average |
| Alabama | 3,878,947 | $527,022 | $0.136 | 2,397,530 | $217,014 | $0.091 |
| Colorado | | | | | | |
| Illinois | 19,568,662 | 4,051,776 | .207 | 933,027 | 40,529 | .043 |
| Indiana | 7,309,260 | 2,209,537 | .302 | 1,178,585 | 227,337 | .193 |
| Maryland | 6,174,055 | (2) | (2) | | | |
| Massachusetts | 12,155,063 | (2) | (2) | 48,892 | (2) | (2) |
| Michigan | 3,916,893 | 749,693 | .191 | 6,064,047 | 458,545 | .076 |
| Minnesota | 4,112,079 | 1,389,546 | .338 | | | |
| New Jersey | 12,980,017 | (2) | (2) | | | |
| New York | 34,792,173 | 13,493,835 | .388 | 1,466,746 | 316,556 | .216 |
| Ohio | 7,533,563 | 1,504,569 | .200 | 3,363,836 | 360,140 | .107 |
| Pennsylvania | 17,396,608 | 5,177,371 | .298 | 7,172,340 | 619,607 | .086 |
| Tennessee | 500,211 | 161,615 | .323 | | | |
| Utah | 505,809 | (2) | (2) | 152,550 | (2) | (2) |
| Washington | 264,932 | 96,446 | .364 | | | |
| West Virginia | | | | 2,070,129 | 334,518 | .162 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 19,848,396 | 6,517,221 | .328 | 2,910,202 | 317,255 | .109 |
| Undistributed | | 6,779,194 | .213 | | 23,455 | .116 |
| Grand total, 1937 | 150,936,668 | 42,657,825 | .283 | 27,757,884 | 2,914,956 | .105 |
| At merchant plants | 111,786,375 | 34,426,693 | .308 | 17,697,943 | 1,973,571 | .112 |
| At furnace plants | 39,150,293 | 8,231,132 | .210 | 10,059,941 | 941,385 | .094 |
| Grand total, 1936 | 156,063,794 | 44,711,670 | .286 | 22,538,584 | 2,637,779 | .117 |
| Change in 1937, percent | −3.3 | −4.6 | −1.0 | +23.2 | +10.5 | −10.3 |

[2] Included under "Undistributed."

## TAR

TABLE 47.—*Coke-oven tar produced and sold in the United States in 1937, by States, in gallons* [1]

| State | Produced [3] | | Sold | | | | |
|---|---|---|---|---|---|---|---|
| | Total | Per ton of coal coked | For use as fuel [3] | For refining into tar products | Total sold | Value | |
| | | | | | | Total | Average |
| Alabama | 49,708,921 | 8.44 | 13,203,979 | 19,628,010 | 32,831,989 | $1,537,644 | $0.047 |
| Colorado | 7,739,960 | 10.71 | | 914,552 | 914,552 | (4) | (4) |
| Illinois | 33,000,822 | 7.76 | 5,056,259 | 26,281,660 | 31,337,919 | 1,507,873 | .048 |
| Indiana | 50,963,172 | 6.72 | 6,178,595 | 17,693,794 | 23,872,389 | 1,157,287 | .048 |
| Maryland | 15,944,609 | 7.65 | | 16,664,611 | 16,664,611 | (4) | (4) |
| Massachusetts | 12,823,356 | 7.94 | 582,930 | 12,188,282 | 12,771,212 | (4) | (4) |
| Michigan | 25,798,473 | 8.03 | 11,227,519 | 14,532,308 | 25,759,827 | 1,301,725 | .051 |
| Minnesota | 7,666,070 | 7.64 | | 7,761,536 | 7,761,536 | 417,224 | .054 |
| New Jersey | 11,098,776 | 7.74 | 3,247,485 | 7,621,704 | 10,869,189 | (4) | (4) |
| New York | 62,965,714 | 9.13 | 12,069,970 | 47,676,220 | 59,746,190 | 2,778,347 | .047 |
| Ohio | 75,430,626 | 8.02 | 15,406,534 | 47,958,077 | 63,364,611 | 3,272,044 | .052 |
| Pennsylvania | 200,816,522 | 10.09 | 29,157,340 | 25,637,892 | 54,795,232 | 2,119,076 | .039 |
| Tennessee | 800,290 | 6.17 | | 812,698 | 812,698 | 32,496 | .040 |
| Utah | 3,041,764 | 11.52 | | 3,084,116 | 3,084,116 | (4) | (4) |
| Washington | 136,447 | 5.22 | 170,543 | | 170,543 | 4,264 | .025 |
| West Virginia | 25,607,885 | 9.96 | | 22,717,778 | 22,717,778 | 1,157,858 | .051 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 19,509,881 | 7.58 | | 19,174,086 | 19,174,086 | 943,124 | .049 |
| Undistributed | | | | | | 2,227,521 | .050 |
| Grand total, 1937 | 603,053,288 | 8.67 | 96,301,154 | 290,347,324 | 386,648,478 | 18,456,483 | .048 |
| At merchant plants | 151,574,528 | 8.33 | 12,429,005 | 134,859,391 | 147,288,396 | 6,857,961 | .047 |
| At furnace plants | 451,478,760 | 8.79 | 83,872,149 | 155,487,933 | 239,360,082 | 11,598,522 | .048 |
| Grand total, 1936 | 560,385,578 | 8.86 | 118,537,218 | 239,645,541 | 358,182,759 | 15,328,340 | .043 |
| Change in 1937, percent | +7.6 | −2.1 | −18.8 | +21.2 | +7.9 | +20.4 | +11.6 |

[1] Figures for 1938 not yet available.
[2] Includes 88,588,133 gallons of tar "refined at plant."
[3] Comprises 18,434,195 gallons sold to affiliated corporations and 77,866,959 gallons sold to other purchasers.
[4] Included under "Undistributed."

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TABLE 47.—*Coke-oven tar produced and sold in the United States in 1937, by States, in gallons*—Continued

| State | Used by producer [5] | | | On hand Dec. 31 |
|---|---|---|---|---|
| | As fuel under boilers | In open hearth or affiliated plants | Otherwise | |
| Alabama | 671,889 | 13,648,017 | 261,959 | 4,512,639 |
| Colorado | | 3,147,156 | 74,730 | 255,377 |
| Illinois | | 117,822 | | 2,860,710 |
| Indiana | | 28,080,741 | 13,104 | 1,949,925 |
| Maryland | | 17,476 | | 1,164,915 |
| Massachusetts | | | | 411,022 |
| Michigan | | | 8,650 | 2,339,541 |
| Minnesota | | | | 367,543 |
| New Jersey | | | | 888,077 |
| New York | | 729,753 | 8,614 | 3,204,398 |
| Ohio | 489,180 | 9,601,831 | 193,161 | 2,041,485 |
| Pennsylvania | 968,229 | 63,064,255 | 1,461,804 | 10,581,700 |
| Tennessee | | | | 19,958 |
| Utah | | | | 104,975 |
| Washington | | | | |
| West Virginia | | 3,071,421 | | 481,901 |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | | | 1,558 | 936,808 |
| Undistributed | | | | |
| Grand total, 1937 | 2,129,298 | 121,478,472 | 2,023,580 | 32,120,974 |
| At merchant plants | | | 10,574 | 8,181,716 |
| At furnace plants | 2,129,298 | 121,478,472 | 2,013,006 | 23,939,258 |
| Grand total, 1936 | 1,739,326 | 145,623,890 | 476,029 | 29,413,219 |
| Change in 1937, percent | +22.4 | −16.6 | +325.1 | +9.2 |

[5] Excludes 88,588,133 gallons of tar "refined at plant" that cannot be shown by States without disclosing individual operations.

## AMMONIA

TABLE 48.—*Ammonia produced at coke-oven plants and sold in 1937, by States, in pounds* [1]

| State | Active plants | Sulfate equivalent of all forms | | Produced as— | |
|---|---|---|---|---|---|
| | | Total | Per ton of coal coked | Sulfate | Liquor ($NH_3$ content) |
| Alabama | 7 | 144,118,327 | 24.48 | 125,122,491 | 4,748,959 |
| Colorado | 1 | 16,955,200 | 23.46 | 16,955,200 | |
| Illinois | 7 | 87,201,369 | 21.03 | 64,608,729 | 5,648,160 |
| Indiana | 6 | 143,042,231 | 18.85 | 125,946,503 | 4,273,932 |
| Maryland | 1 | 43,949,685 | 21.08 | 43,949,685 | |
| Massachusetts | 2 | 37,725,092 | 23.35 | 34,976,300 | 687,198 |
| Michigan | 8 | 66,067,708 | 20.56 | 30,916,008 | 8,787,925 |
| Minnesota | 3 | 16,582,715 | 16.54 | 16,582,715 | |
| New Jersey | 2 | 28,224,885 | 19.68 | 28,224,885 | |
| New York | 8 | 150,853,252 | 21.88 | 121,982,080 | 7,217,793 |
| Ohio | 14 | 200,595,930 | 21.32 | 161,006,658 | 9,897,318 |
| Pennsylvania | 12 | 459,539,764 | 23.08 | 440,520,824 | 4,754,735 |
| Tennessee | 1 | 2,902,694 | 22.39 | 2,902,694 | |
| Utah | 1 | 7,081,508 | 26.82 | 7,081,508 | |
| West Virginia | 3 | 48,989,973 | 23.07 | 48,989,973 | |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 5 | 52,600,918 | 20.68 | 19,974,486 | 8,156,608 |
| Undistributed | | | | | |
| Grand total, 1937 | 81 | 1,506,431,251 | 21.84 | 1,289,740,739 | 54,172,628 |
| At merchant plants | 38 | 383,408,295 | 21.79 | 223,446,603 | 39,990,423 |
| At furnace plants | 43 | 1,123,022,956 | 21.86 | 1,066,294,136 | 14,182,205 |
| Grand total, 1936 | 81 | 1,388,682,583 | 22.14 | 1,199,645,603 | 47,259,245 |
| Change in 1937, percent | | +8.5 | −1.4 | +7.5 | +14.6 |

[1] Figures for 1938 not yet available.

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TABLE 48.—*Ammonia produced at coke-oven plants and sold in 1937, by States, in pounds*—Continued

| State | Sold as— | | | |
|---|---|---|---|---|
| | Sulfate | | Liquor ($NH_3$ content) | |
| | Pounds | Value | Pounds | Value |
| Alabama | 113,653,896 | $1,444,208 | 4,784,357 | $162,191 |
| Colorado | 18,122,919 | (3) | | |
| Illinois | 64,060,092 | 643,549 | 5,730,533 | (3) |
| Indiana | 116,869,983 | 1,240,291 | 4,169,886 | 104,331 |
| Maryland | 42,177,338 | (3) | | |
| Massachusetts | 39,356,420 | (3) | 678,941 | (3) |
| Michigan | 29,651,214 | 383,227 | 8,269,123 | 228,120 |
| Minnesota | 16,273,677 | 173,639 | | |
| New Jersey | 28,648,344 | (3) | | |
| New York | 131,875,257 | 1,479,412 | 7,254,510 | 228,053 |
| Ohio | 168,387,179 | 1,780,207 | 9,365,816 | 295,474 |
| Pennsylvania | 479,838,829 | 4,980,271 | 4,240,291 | 143,464 |
| Tennessee | 2,013,000 | 26,572 | | |
| Utah | 7,769,855 | (3) | | |
| West Virginia | 54,501,171 | 587,129 | | |
| Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin | 19,109,574 | 229,484 | 7,901,260 | 200,278 |
| Undistributed | | 1,509,245 | | 209,180 |
| Grand total, 1937 | 1,332,308,748 | 14,477,234 | 52,394,717 | 1,571,091 |
| At merchant plants | 230,626,834 | 2,608,117 | 39,278,125 | 1,177,106 |
| At furnace plants | 1,101,681,914 | 11,869,117 | 13,116,592 | 393,985 |
| Grand total, 1936 | 1,123,343,067 | 11,484,191 | 46,907,237 | 1,328,788 |
| Change in 1937, percent | +18.6 | +26.1 | +11.7 | +18.2 |

[3] Included under "Undistributed."

## LIGHT OIL AND ITS DERIVATIVES

TABLE 49.—*Crude light oil produced at coke-oven plants in the United States and derived products obtained and sold in 1937, by States, in gallons* [1]

| State | Active plants | Produced | | Refined on premises | Total derived products obtained from refining operations | Total derived products sold [2] | Value of derived products sold [2] |
|---|---|---|---|---|---|---|---|
| | | Total | Per ton of coal coked | | | | |
| Alabama | 7 | 16,536,053 | 2.81 | 15,262,617 | 13,424,517 | 12,875,046 | $1,479,368 |
| Colorado | 1 | 2,325,559 | 3.22 | 2,320,022 | 1,803,373 | 1,644,311 | (3) |
| Illinois | 5 | 9,925,300 | 2.56 | 5,115,126 | 4,233,636 | 4,166,055 | 495,684 |
| Indiana | 4 | 18,983,999 | 2.70 | 19,547,814 | 16,722,110 | 16,874,784 | 2,152,623 |
| Maryland | 1 | 6,238,540 | 2.99 | 6,217,697 | 5,370,217 | 5,526,498 | (3) |
| Michigan | 3 | 7,201,206 | 2.50 | 4,875,833 | 4,414,562 | 803,441 | (3) |
| New York | 7 | 15,761,103 | 2.56 | 26,042,804 | 22,166,551 | 22,727,293 | 3,387,363 |
| Ohio | 14 | 26,480,820 | 2.81 | 25,210,713 | 20,271,494 | 20,118,453 | 2,694,724 |
| Pennsylvania | 10 | 61,353,947 | 3.26 | 59,657,052 | 52,684,412 | 51,454,445 | 5,992,680 |
| Tennessee | 1 | 299,718 | 2.31 | 301,893 | 221,814 | 219,054 | 27,998 |
| Utah | 1 | 1,058,706 | 4.01 | 1,054,733 | 810,883 | 798,328 | (3) |
| West Virginia | 4 | 8,503,995 | 3.31 | 8,543,251 | 7,359,042 | 6,975,646 | 998,765 |
| Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey and Wisconsin | 8 | 12,385,400 | 2.20 | 7,881,240 | 7,019,695 | 6,921,701 | 1,041,642 |
| Undistributed | | | | | | | 989,098 |
| Grand total 1937 | 66 | 187,054,346 | 2.86 | 182,030,795 | 156,502,306 | 151,105,055 | 19,259,945 |
| At merchant plants | 25 | 34,488,753 | 2.35 | 30,879,561 | 26,911,840 | 27,091,829 | 4,052,719 |
| At furnace plants | 41 | 152,565,593 | 3.01 | 151,151,234 | 129,590,466 | 124,013,226 | 15,207,226 |
| Grand total, 1936 | 62 | 170,234,202 | 2.91 | 163,990,960 | 140,972,234 | 136,294,329 | 17,967,013 |
| Change in 1937, percent | +6.5 | +9.9 | −1.7 | +11.0 | +11.0 | +10.9 | +7.2 |

[1] Figures for 1938 not yet available.
[2] Excludes 11,113,150 gallons valued at $955,459 of crude oil sold as such.
[3] Included under "Undistributed."

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## NAPHTHALENE

TABLE 50.—*Crude and refined naphthalene sold by byproduct-coke operators, 1933–37* [1]

| Year | Pounds | Value | | Receipts per ton of coke (cents) |
|---|---|---|---|---|
| | | Total | Average receipts per pound (cents) | |
| 1933 | 6,523,204 | $67,472 | 1.0 | 0.3 |
| 1934 | 10,500,285 | 131,299 | 1.3 | .4 |
| 1935 | 13,214,108 | 167,632 | 1.3 | .5 |
| 1936 | 34,946,890 | 570,295 | 1.6 | 1.3 |
| 1937 | 60,315,581 | 1,182,992 | 2.0 | 2.4 |

[1] Figures for 1938 not yet available.

## BYPRODUCT COKE OVENS OWNED BY CITY-GAS COMPANIES (PUBLIC UTILITY PLANTS)

Adaptation of the byproduct coke oven to the needs of city-gas manufacture has led a number of gas companies to install batteries of byproduct ovens to supplement or even to replace their coal or water-gas plants. From the point of view of ownership and accounting, these installations are part of the gas utility system, and the Bureau of the Census therefore groups them with the manufactured-gas industry under the title "The Gas and Coke Industries."

From other points of view, however, these installations belong to the byproduct coke industry. The coke produced is superior to gas-house coke. In the practical operation of a byproduct coke plant the fact that the gas may be distributed through city mains has less consequence than the fact that the coke must be marketed for foundry, furnace, or household use. Considered with reference to oven design and the technique of manufacture, and still more with reference to the supply and demand for coke, these ovens should be included with other byproduct coke plants; they are so included in the statistics published by the Bureau of Mines.

These differences in classification are followed by the Bureau of the Census and the Bureau of Mines after consultation with leaders of the gas and coke industries, and the two offices have collaborated in the collection and analysis of the statistics.

The following table presents the salient features of the byproduct coke industry separated with respect to plants owned by city-gas companies and those not so owned.

That the public utility plants have been increasing in number and volume of output is evidenced by the fact that the number rose from 9 in 1918 to 21 in 1929. In the latter year the coke produced from the 21 active plants amounted to 3,232,307 tons, or 6 percent of the total output of byproduct coke. In 1938, with only 18 plants active, the coke product was 3,247,548 tons, a little more than 10 percent of national production.

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TABLE 51.—*Production of coke, breeze, gas, and byproducts at byproduct coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other byproduct coke plants, 1936–37* [1]

| Product | 1936 | | | 1937 | | |
|---|---|---|---|---|---|---|
| | Plants not owned by city gas companies | Plants owned by city gas companies (public utilities) [2] | Total | Plants not owned by city gas companies | Plants owned by city gas companies (public utilities) [2] | Total |
| Number of active plants | 64 | 21 | 85 | 65 | 20 | 85 |
| Coke: | | | | | | |
| Production—net tons | 40,954,836 | 3,614,285 | 44,569,121 | 45,699,231 | 3,511,517 | 49,210,748 |
| Value | $202,419,225 | $23,276,494 | $225,695,719 | $223,873,967 | $23,481,785 | $247,355,752 |
| Average value | $4.94 | $6.44 | $5.06 | $4.90 | $6.69 | $5.03 |
| Screenings or breeze: | | | | | | |
| Production—net tons | 3,232,638 | 344,584 | 3,577,222 | 3,577,183 | 306,515 | 3,883,698 |
| Sales—do | 670,835 | 27,083 | 697,918 | 633,108 | 24,037 | 657,145 |
| Value | $1,406,193 | $70,852 | $1,477,045 | $1,473,253 | $61,884 | $1,535,137 |
| Average value | $2.10 | $2.62 | $2.12 | $2.33 | $2.57 | $2.34 |
| Coal charged into ovens: | | | | | | |
| Quantity—net tons | 58,110,600 | 5,132,917 | 63,243,517 | 64,594,504 | 4,980,869 | 69,575,373 |
| Coke: | | | | | | |
| Used by producer: | | | | | | |
| Quantity—net tons | [3] 27,987,459 | 994,000 | [3] 28,981,459 | 31,500,121 | 729,776 | 32,229,897 |
| Value | [3] $128,119,293 | $6,138,951 | [3] $134,258,244 | $139,929,373 | $4,368,964 | $144,298,337 |
| Sales: | | | | | | |
| Quantity—net tons | 13,762,584 | 2,784,083 | 16,546,667 | 13,407,427 | 2,742,688 | 16,150,115 |
| Value | $78,348,913 | $18,089,137 | $96,438,050 | $79,857,905 | $18,840,495 | $98,698,400 |
| Byproducts: | | | | | | |
| Gas: | | | | | | |
| Production M cubic feet | 640,547,854 | 59,153,561 | 699,701,415 | 699,623,138 | 58,005,804 | 757,628,942 |
| Sales of surplus: | | | | | | |
| Used under boilers: | | | | | | |
| Quantity M cubic feet | 28,705,273 | 102,345 | 28,807,618 | 32,750,748 | 26,010 | 32,776,758 |
| Value | $1,754,280 | $10,189 | $1,764,469 | $1,968,036 | $1,657 | $1,969,693 |
| Used in steel or affiliated plants: | | | | | | |
| Quantity M cubic feet | 226,211,134 | 17,911 | 226,229,045 | 251,552,978 | 18,671 | 251,571,649 |
| Value | $21,707,660 | $9,392 | $21,717,052 | $25,413,963 | $5,260 | $25,419,223 |
| Distributed through city mains: | | | | | | |
| Quantity M cubic feet | 104,592,472 | 51,471,322 | 156,063,794 | 99,374,929 | 51,561,739 | 150,936,668 |
| Value | $26,656,284 | $18,055,386 | $44,711,670 | $24,734,750 | $17,923,075 | $42,657,825 |
| Sold for industrial use: | | | | | | |
| Quantity M cubic feet | 21,096,829 | 1,441,755 | 22,538,584 | 26,290,137 | 1,467,747 | 27,757,884 |
| Value | $2,204,768 | $433,011 | $2,637,779 | $2,515,049 | $399,907 | $2,914,956 |
| Tar: | | | | | | |
| Production—gallons | 510,765,616 | 49,619,962 | 560,385,578 | 555,607,964 | 47,445,324 | 603,053,288 |
| Sales: | | | | | | |
| Quantity—do | 309,380,205 | 48,802,554 | 358,182,759 | 341,254,792 | 45,393,686 | 386,648,478 |
| Value | $13,236,605 | $2,091,735 | $15,328,340 | $16,397,396 | $2,059,087 | $18,456,483 |
| Average value | $0.043 | $0.043 | $0.043 | $0.048 | $0.045 | $0.048 |
| Ammonia: | | | | | | |
| Production ($NH_3$ equivalent of all forms) pounds | 320,861,321 | 26,309,324 | 347,170,645 | 350,803,763 | 25,804,050 | 376,607,813 |
| Liquor ($NH_3$ content): | | | | | | |
| Production—pounds | 42,707,324 | 4,551,921 | 47,259,245 | 49,717,008 | 4,455,620 | 54,172,628 |
| Sales—do | 42,315,907 | 4,591,330 | 46,907,237 | 47,970,372 | 4,424,345 | 52,394,717 |
| Value | $1,238,752 | $90,036 | $1,328,788 | $1,482,593 | $88,498 | $1,571,091 |
| Sulfate: | | | | | | |
| Production—pounds | 1,112,615,989 | 87,029,614 | 1,199,645,603 | 1,204,347,020 | 85,393,719 | 1,289,740,739 |
| Sales—do | 1,044,424,839 | 78,918,228 | 1,123,343,067 | 1,246,437,212 | 85,871,536 | 1,332,308,748 |
| Value | $10,653,237 | $830,954 | $11,484,191 | $13,533,822 | $943,412 | $14,477,234 |
| Crude light oil: | | | | | | |
| Production—gallons | 166,275,705 | 3,958,497 | 170,234,202 | 183,223,825 | 3,830,521 | 187,054,346 |
| Sales—do | 7,483,501 | 2,879,675 | 10,363,176 | 8,322,515 | 2,790,635 | 11,113,150 |
| Value | $722,799 | $248,965 | $971,764 | $707,807 | $247,652 | $955,459 |

[1] Figures for 1938 not yet available.

[2] Includes all byproduct ovens built by city gas companies, some of which are operated in conjunction with coal, oil, and water gas plants. Does not include independent byproduct plants, which may sell gas to public utility companies for distribution.

[3] Revised figures.

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TABLE 51.—*Production of coke, breeze, gas, and byproducts at byproduct coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other byproduct coke plants, 1936–37*—Continued

| Product | 1936 | | | 1937 | | |
|---|---|---|---|---|---|---|
| | Plants not owned by city gas companies | Plants owned by city gas companies (public utilities) | Total | Plants not owned by city gas companies | Plants owned by city gas companies (public utilities) | Total |
| Byproducts—Contd. | | | | | | |
| Light oil derivatives: | | | | | | |
| Production....gallons.. | 140,137,380 | 834,854 | 140,972,234 | 155,610,298 | 892,008 | 156,502,306 |
| Sales.....do.... | 135,476,381 | 817,948 | 136,294,329 | 150,225,547 | 879,508 | 151,105,055 |
| Value | $17,845,767 | $121,246 | $17,967,013 | $19,128,211 | $131,734 | $19,259,945 |
| Naphthalene, crude and refined: | | | | | | |
| Production....pounds.. | 37,395,607 | 156,612 | 37,552,219 | 59,863,754 | 933,354 | 60,797,108 |
| Sales.....do.... | 34,793,228 | 153,662 | 34,946,890 | 59,384,227 | 931,354 | 60,315,581 |
| Value | $567,549 | $2,746 | $570,295 | $1,167,536 | $15,456 | $1,182,992 |
| All other products, value | $1,655,909 | $68,363 | $1,724,272 | $3,126,280 | $133,657 | $3,259,937 |

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# FUEL BRIQUETS AND PACKAGED FUEL [1]

By G. S. Goodman

## SUMMARY OUTLINE


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The domestic production of fuel briquets in 1938 totaled 871,260 net tons valued at $5,701,890. This represents a decrease in quantity of 12.5 percent from 1937 and 23 percent from 1936. The decline in 1938 was due principally to the mild winter, but it is believed that unsettled coal prices also may have been partly responsible.

Despite the curtailment in output, interest in fuel briquetting appears to be gaining, as evidenced by the 35 plants in operation in 1938 (8 of them new), the largest number since the beginning of the industry. Three other plants were under construction or being operated experimentally at the end of the year.

The production of packaged fuel in 1938 increased 10 percent, reaching a total of 160,952 tons valued at $1,405,253 compared with 146,037 tons valued at $1,287,320 in 1937. The gain, however, was not so marked as in 1937, when the production was more than double that of 1936. Operators reported that their output in 1938 would have been considerably greater if winter temperatures had been normal.

Reports received by the Bureau of Mines on fuel-briquetting and packaged-fuel operations for 1938 show that these two industries apparently are not competitive, as fuel briquets are designed to stand shipment for a considerable distance whereas packaged fuel is principally for local or nearby consumption. The average fuel-briquetting plant in 1938 produced about 25,000 tons a year and shipped by rail to far destinations, while the average packaged-fuel plant produced only about 3,000 tons, mostly for local consumption.

Statistics on fuel briquets and packaged fuel are presented separately in this report.

[1] Directories of fuel-briquetting and packaged-fuel plants operating in 1938 and names of manufacturers of equipment will be furnished on request by the Coal Economics Division, Bureau of Mines, Washington, D. C.



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## FUEL BRIQUETS

The salient statistics of the fuel-briquetting industry from 1934 to 1938 are summarized in the following table.

*Salient statistics of the fuel-briquet industry in the United States, 1934–38*

[Data regarding packaged fuel are given separately at end of this report]

| Year | Production | | | | Imports | Exports [1] | Consumption [2] | Value of production (thousands of dollars) | Plants in operation | Average output per plant (thousands of net tons) | Average value per net ton, f. o. b. plant | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Eastern States | Central States | Pacific Coast States | Total | | | | | | | Eastern States | Central States | Pacific Coast States |
| | Thousands of net tons | | | | | | | | | | | | |
| 1934 | 264 | 388 | 53 | 705 | ------ | (1) | 705 | 4,276 | 27 | 26 | $4.72 | $6.54 | $9.33 |
| 1935 | 310 | 485 | 66 | 861 | 17 | (1) | 878 | 5,476 | 29 | 30 | 4.48 | 7.16 | 9.29 |
| 1936 | 351 | 702 | 72 | 1,125 | 20 | (1) | 1,145 | 7,043 | 32 | 35 | 4.19 | 6.95 | 9.64 |
| 1937 | 271 | 636 | 89 | 996 | 7 | 25 | 978 | 6,394 | 31 | 32 | 4.19 | 7.01 | 8.94 |
| 1938 | 251 | 546 | 74 | 871 | 14 | 17 | 868 | 5,702 | 35 | 25 | 4.34 | 7.18 | 9.38 |

[1] Exports not reported separately by Bureau of Foreign and Domestic Commerce prior to 1937.
[2] Production plus imports minus exports.

*Production.*—Production of briquets in 1938 totaled 871,260 net tons, a decrease of 124,670 tons (12.5 percent) from 1937. (See fig. 1.) The greatest relative decrease was in the Pacific Coast States.

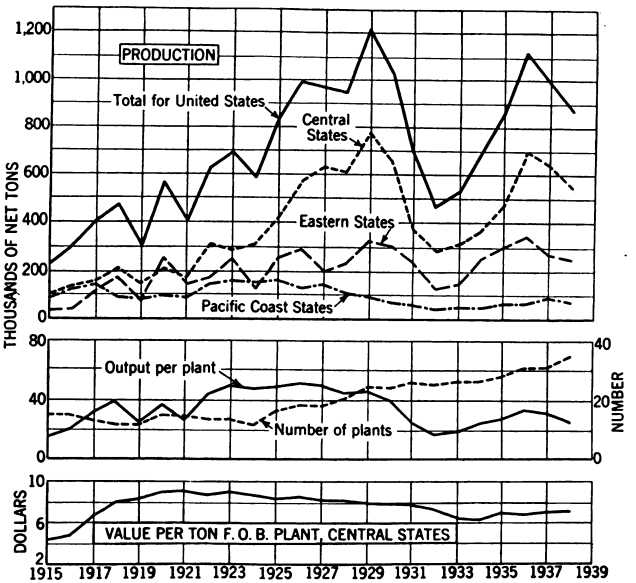


FIGURE 1.—Production of fuel briquets, number of plants in operation, and average value per net ton, f. o. b. plant (Central States), 1915–38.

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*Fuel briquets produced in the United States, 1937–38*

| | 1937 | | | 1938 | | | | |
|---|---|---|---|---|---|---|---|---|
| | Plants | Net tons | Value | Plants | Net tons | Value | Percent of change in— | |
| | | | | | | | Tonnage | Value |
| Eastern States | 4 | 270,451 | $1,132,734 | 4 | 251,443 | $1,090,055 | −7.0 | −3.8 |
| Central States | 22 | 636,352 | 4,463,788 | 25 | 545,848 | 3,917,936 | −14.2 | −12.2 |
| Pacific Coast States | 5 | 89,127 | 797,201 | 6 | 73,969 | 693,899 | −17.0 | −13.0 |
| | 31 | 995,930 | 6,393,723 | [1] 35 | 871,260 | 5,701,890 | −12.5 | −10.8 |

[1] Includes 10 plants in Wisconsin; 3 each in Minnesota, North Dakota, and Washington; 2 each in California, Michigan, Nebraska, and West Virginia; and 1 each in Arkansas, Illinois, Massachusetts, Missouri, Ohio, Oregon, Pennsylvania, and Wyoming.

The decrease in output of fuel briquets in the Eastern and Central States can be attributed to the mild winter of 1938. Production in the Pacific Coast States, although 17 percent below 1937, was about normal in 1938; production was unusually high in 1937 because of severe freezes in January of that year. The winter of 1938 was so mild that orchard heating—an important market for this fuel on the Pacific coast—was unnecessary.

Wisconsin produces about half the total; West Virginia, Pennsylvania, Oregon, and Missouri follow in order of tonnage produced in 1938. Michigan, Minnesota, Nebraska, Washington, West Virginia, and Wyoming increased their output in 1938.

The following table shows production and value for 1938 in those States for which the figures can be published without revealing operations of individual companies.

*Fuel briquets produced in Wisconsin, North Dakota, Minnesota, and Washington*

| State | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Plants | Net tons | Value | Plants | Net tons | Value |
| Minnesota | 3 | 20,905 | $162,136 | 3 | 22,840 | $219,428 |
| North Dakota | 1 | (1) | (1) | 3 | 27,071 | 183,655 |
| Washington | 2 | (1) | (1) | 3 | 13,525 | 104,162 |
| Wisconsin | 10 | 507,462 | 3,639,183 | 10 | 422,281 | 3,085,873 |

[1] Bureau of Mines not at liberty to publish figures.

*Monthly production of fuel briquets in the United States, 1936–38, in net tons*

| Month | 1936 | 1937 | 1938 | Month | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|
| January | 146,469 | 140,969 | 141,397 | August | 53,454 | 43,389 | 51,098 |
| February | 209,765 | 92,816 | 79,414 | September | 78,889 | 87,153 | 78,128 |
| March | 68,593 | 47,872 | 36,556 | October | 129,829 | 128,266 | 87,446 |
| April | 40,870 | 36,541 | 28,806 | November | 134,250 | 113,809 | 99,651 |
| May | 45,421 | 71,077 | 49,599 | December | 127,810 | 135,894 | 120,351 |
| June | 52,638 | 57,936 | 61,531 | | | | |
| July | 36,985 | 40,208 | 37,283 | | 1,124,973 | 995,930 | 871,260 |

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*Value.*—The total sales value of the briquets manufactured in 1938 was $5,701,890, f. o. b. plant, 11 percent below 1937. The loss in total value is due to the 12.5-percent decrease in production, as the average value per ton rose from $6.42 in 1937 to $6.54 in 1938.

The average for the entire industry is of doubtful significance because of variations in the cost of raw fuel to briquetting plants and in market prices of competing fuels.

The average value per net ton in the Eastern States in 1938 was $4.34, in the Central States $7.18, and in the Pacific Coast States $9.38. These figures do not represent the prices paid by the ultimate consumer.

In the Eastern States the entire output comes from plants in the low-volatile coal fields of southern West Virginia and in the anthracite region of Pennsylvania, where the cost of raw fuel does not involve freight charges. As a result, the f. o. b. value of briquets at these plants is relatively low. In the Central States most of the production comes from plants at coal docks on Lakes Michigan and Superior; the raw fuel for these plants involves a considerable freight charge.

*Technical developments.*—Interest continues in technical research and experimentation. However, no new methods were put into commercial operation in 1938, so far as is known, except at a plant in California where residual carbon from the pyrolysis [2] of natural gas is being used as raw fuel, with the addition of a 14-percent asphaltic pitch binder.

Attention is called to recent papers and discussion on the manufacture of fuel briquets by C. C. Morfit, C. A. Jacobson, and J. L. Knight.[3]

The appeal of packaged products has also penetrated the field of bulk briquets. Two new fuel-briquetting plants have included bagging machinery in their equipment. The product of both plants is the small pillow-shaped briquet, automatically sacked in bags of about 15 pounds and sold locally.

Another briquetting plant, making 3-inch cubes, wrapped several thousand tons (about one-third of its production) in 10-pound packages.

One of the larger briquetting operations, which makes Pennsylvania anthracite briquets, reports that retail dealers are bagging increasing quantities of its product in 17-, 25-, and 50-pound bags.

*Number of plants.*—Thirty-five plants reported commercial production in 1938, the largest number of active fuel-briquetting plants in the history of the industry. Of these, eight are new (one each in California, Michigan, Minnesota, Nebraska, Ohio, and Washington and two in North Dakota).

Three additional plants, situated in Michigan, Pennsylvania, and Texas, were under construction and in experimental operation in 1938.

Sixteen plants were idle in 1938, of which 13 were also idle in 1937. Seven plants went out of business in 1938, but two of these were active part of the year.

[2] The chemical decomposition of substances by the action of heat.

[3] Morfit, C. C., Observations—Fuel Briquet Manufacture: Paper presented at the Second Annual Coal Conference, West Virginia University, Morgantown, W. Va., Nov. 11, 1938, and published in The Proceedings of the Second Annual Coal Conference, West Virginia Univ. Bull. Ser. 39, No. 8, February 1939, pp. 147–155.

Jacobson, C. A., Discussion of Mr. C. C. Morfit's Paper: West Virginia Univ. Bull. Ser. 39, No. 8, February 1939, pp. 156–159.

Knight, J. L., What Factors are Important in Briquetting?: Coal Age, vol. 43, No. 9, September 1938, pp. 34–35.

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*Size of plants.*—The following table classifies the plants according to actual production as well as actual capacities; however, a better indication of the size of plants is gained from their capacity, even though the latter is definitely affected by seasonal variations in production.

The total annual capacity of the 35 plants operating in 1938, as reported by the operators, is 3,111,800 net tons, whereas production was only 871,260 tons. The estimated annual capacity of the eight new plants is about 107,500 tons.

*Classification of briquetting plants in 1938, by size of output and annual capacity*

| Output (net tons) | Plants | Annual capacity (net tons) | Plants |
|---|---|---|---|
| Less than 2,000 | 11 | Less than 5,000 | 3 |
| 2,000 and less than 5,000 | 4 | 5,000 and less than 10,000 | 5 |
| 5,000 and less than 10,000 | 5 | 10,000 and less than 25,000 | 8 |
| 10,000 and less than 25,000 | 5 | 25,000 and less than 100,000 | 12 |
| 25,000 and less than 100,000 | 8 | 100,000 and less than 200,000 | 2 |
| 100,000 and over | 2 | 200,000 and less than 400,000 | 3 |
| | | 400,000 and over | 2 |
| | [1] 35 | | [1] 35 |

[1] 16 plants operated 12 months of the year; 10 plants from 7 to 11 months; and 9 plants less than 5 months

*Raw fuels.*—The total quantity of raw fuel briquetted in 1938 was 836,407 net tons, of which low-volatile bituminous coal formed the greater part. Fourteen plants used 296,133 tons of low-volatile coal exclusively; the total low-volatile utilized amounted to 501,325 net tons—60 percent of the total raw-fuel tonnage.

Nine operators, using 371,139 tons of anthracite and bituminous coal, reported that the raw fuel was washed before it was manufactured into briquets.

*Classification of fuel-briquetting plants by kinds of raw fuel used in 1938*

| Kind of raw fuel used: | *Plants* |
|---|---|
| Anthracite or semianthracite fines exclusively | 3 |
| Mixture of anthracite or semianthracite and bituminous | 5 |
| Bituminous: | |
| Low-volatile | 14 |
| High-volatile | [1] 2 |
| Semicoke (lignite char) | 3 |
| Mixture of petroleum coke with anthracite or bituminous | 3 |
| Residual carbon from pyrolysis of natural gas | 1 |
| Residual carbon from manufacture of oil gas | 2 |
| Petroleum coke | 2 |
| | 35 |

[1] 1 plant using high-volatile coal also reported using residual carbon from manufacture of oil gas.

*Raw fuels used in making briquets in the United States, 1929 and 1936–38*

| | Net tons | | | | Percent of total | | | |
|---|---|---|---|---|---|---|---|---|
| | 1929 | 1936 | 1937 | 1938 | 1929 | 1936 | 1937 | 1938 |
| Anthracite and semianthracite culm and fine sizes | 408,967 | 296,806 | 252,572 | 200,347 | 34.4 | 27.8 | 26.5 | 23.9 |
| Bituminous and subbituminous slack | 711,459 | 645,896 | 569,815 | 505,917 | 59.9 | 60.6 | 59.9 | 60.5 |
| Semicoke, coke, oil-gas residue, or petroleum coke | 67,513 | 123,868 | 129,278 | [1] 130,143 | 5.7 | 11.6 | 13.6 | 15.6 |
| | 1,187,939 | 1,066,570 | 951,665 | 836,407 | 100.0 | 100.0 | 100.0 | 100.0 |

[1] Includes residual carbon from pyrolysis of natural gas at plant in California.

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Important factors that control the success of a briquetting plant are its location with relation to the source of the raw-fuel supply and to the consuming market for the finished product, freight rates, cost of raw fuel, and prices of competing fuels to the consumer. As borne out in the following table, the plants drawing upon the nearby Lake docks for their raw fuel produced approximately half of the total output in 1938.

*Fuel briquets produced in the United States, 1937–38, with reference to supply of raw fuel*

| Location of plant | Net tons | | Change in 1938 compared with 1937 | |
|---|---|---|---|---|
| | 1937 | 1938 | Net tons | Percent |
| At or near Lake Superior or Lake Michigan coal docks | 507,462 | 422,717 | −84,745 | −16.7 |
| At coal mines | 325,093 | 292,827 | −32,266 | −9.9 |
| At or near petroleum refineries and oil-gas plants | 91,267 | 84,954 | −6,313 | −6.9 |
| At other locations [1] | 72,108 | 70,762 | −1,346 | −1.9 |
| | 995,930 | 871,260 | −124,670 | −12.5 |

[1] 1937—South Chicago, Ill.; Indianapolis, Ind.; Fall River, Mass.; Jackson, Mich.; Minneapolis and St. Paul, Minn.; Kansas City, Mo.; and Omaha, Nebr. 1938—Same as for 1937, except Indianapolis, Ind.

*Binders and recarbonization.*—Asphaltic pitch continues to be the most frequently used binder. Three plants (two using residual carbon from the manufacture of oil gas and one using low-volatile bituminous coal as their raw fuels) reported that no binder was used. The production of the coal plant was small, and all sales were local. One new plant in California, employing residual carbon from the pyrolysis of natural gas for its raw fuel, reported the use of 14 percent asphaltic pitch.

One producer using anthracite as raw fuel reported partial recarbonization to drive off smoke caused by the binder.

*Classification of briquetting plants in 1938, by type and percentage of binder used*

| Type of binder | Plants | Percentage of binder to raw fuel (by weight) | Plants |
|---|---|---|---|
| Asphaltic pitch | 24 | Less than 5 percent | 5 |
| Coal-tar pitch | 1 | 5 and less than 7 percent | 16 |
| Mixed pitches | 2 | 7 and less than 9 percent | 7 |
| Petroleum asphalt | 2 | 9 percent and over | 4 |
| Starch, asphalt, and water | 1 | No binder | 13 |
| Starch | 2 | | |
| No binder | 13 | | 35 |
| | 35 | | |

[1] Includes 2 plants using residual carbon from manufacture of oil gas and 1 plant using bituminous coal as raw fuel.

*Weight and shape.*—The industry has made virtually no change in the prevalent size and shape of fuel briquets. More than 90 percent of the total tonnage in each year since 1930—the first year for which the Bureau of Mines asked the producers to give information on weight, size, and shape—has consisted of briquets weighing less than 5 ounces.

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*Prevailing weight of briquets produced in 1938*

| Weight (ounces) | Plants | Production | | Weight (ounces) | Plants | Production | |
|---|---|---|---|---|---|---|---|
| | | Net tons | Percent of total | | | Net tons | Percent of total |
| Less than 2 | 5 | 57,107 | 6.5 | 5 and under 6 | 1 | 17,488 | 2.0 |
| 2 and under 3 | 14 | 479,314 | 55.0 | 6 and under 10 | 1 | | |
| 3 and under 4 | 5 | 245,426 | 28.2 | 10 and under 16 | | | |
| 4 and under 5 | 5 | 71,925 | 8.3 | 16 and under 25 | 6 | | |
| | | | | 42 and over | 1 | | |
| | | | | | [1] 35 | 871,260 | 100.0 |

[1] 3 plants made briquets of more than 1 size, hence the sum of the items exceeds the number of active plants. Of the 8 new plants, 5 made briquets between 2 and 5 ounces and 3 between 16 and 42 ounces.

The pillow-shaped briquet continues to be the most popular. Of the 35 plants active in 1938, 25 made pillow-shaped briquets, 6 cubes, and 2 cylindrical. One plant reported making three different shapes—pillow, cube, and cylindrical; another plant made pillow and cylindrical shapes.

*Principal expenses and value added by manufacture.*—Data on the cost of manufacturing fuel briquets and packaged fuel are not collected by the Bureau of Mines.

Information on the principal items of expense (salaries; wages; cost of materials, fuel, electric energy, and contract work; value of product; and value added by manufacture) is collected and published by the Bureau of the Census in alternate years.

The Census classification of the fuel-briquetting industry includes only those establishments with an output valued at $5,000 or more in which briquets are the chief products made. The Bureau of the Census therefore excludes briquets produced at petroleum refineries or at city gas works, but the returns are representative of independent briquetting plants.

Data for 1937 are now available and may be obtained upon application to the Bureau of the Census, United States Department of Commerce, Washington, D. C.

*Distribution.*—In 1938 briquets were shipped to 35 States, the District of Columbia, Alaska, and Canada. Minnesota and Wisconsin consumed about 45 percent of the total, the same proportion as in 1937. States reporting the largest output in 1938 shipped their briquets as follows: From Wisconsin to 9 States; from West Virginia to 18 States and Canada; and from Pennsylvania to 15 States, the District of Columbia, and Canada. The States consuming all or most of their production locally were: Massachusetts, Illinois, Michigan, Minnesota, Nebraska, North Dakota, Ohio, California, Oregon, and Washington.

Particularly noteworthy was the single shipment on January 11, 1938, of about 5,000 tons of briquets in a solid train of 100 cars from Glen Rogers, W. Va., to Toledo, Ohio, for ultimate distribution to customers in Michigan cities.[4]

[4] Coal Heat, vol. 33, No. 2, February 1938, p. 68.

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*Fuel briquets of domestic manufacture consumed in the United States and exported to Canada, 1937–38, in net tons*

| Shipped into— | 1937 | 1938 | Shipped into— | 1937 | 1938 |
|---|---|---|---|---|---|
| Alaska | 92 | 28 | New Jersey | 1,467 | 1,025 |
| Arkansas | 70 | ------- | New York | 36,283 | 26,804 |
| California | 24,500 | 7,551 | North Carolina | 6,581 | 8,706 |
| Connecticut | 2,143 | 1,218 | North Dakota | 62,219 | 56,728 |
| Delaware | 342 | 163 | Ohio | 24,958 | 27,637 |
| District of Columbia | 753 | 418 | Oregon | 44,545 | 36,189 |
| Florida | 468 | 492 | Pennsylvania | 13,657 | 11,015 |
| Georgia | 172 | 28 | Rhode Island | 5,234 | 4,792 |
| Idaho | 307 | 1,340 | South Carolina | 765 | 16,654 |
| Illinois | 36,224 | 30,914 | South Dakota | 54,970 | 35,542 |
| Indiana | 10,433 | 11,985 | Tennessee | 201 | ------- |
| Iowa | 25,618 | 23,618 | Vermont | 335 | 330 |
| Kansas | 6,224 | 4,212 | Virginia | 14,291 | 13,553 |
| Kentucky | 1,611 | 2,571 | Washington | 19,086 | 21,210 |
| Maine | 541 | 786 | West Virginia | 2,502 | 299 |
| Maryland | 2,467 | 2,602 | Wisconsin | 200,581 | 187,407 |
| Massachusetts | 30,524 | 28,971 | Wyoming | ------- | 1,500 |
| Michigan | 48,859 | 59,827 | Canada [1] | 23,288 | 17,031 |
| Minnesota | 251,126 | 195,222 | | 982,048 | 867,399 |
| Missouri | 10,666 | 7,961 | | | |
| Nebraska | 16,706 | 19,272 | | | |
| New Hampshire | 1,239 | 1,798 | | | |

[1] As reported by the operators to the Bureau of Mines; official figures on imports and exports are given in following tables.

In the questionnaire for 1938 the Bureau of Mines for the first time requested information on the tonnage shipped by rail, truck, and waterway. The results, given in the following table, indicate that 80 percent of the tonnage moved by rail and the rest by truck (including local deliveries).

*Fuel-briquet shipments by rail and truck in 1938, in net tons*

| | Rail | Truck [1] | Total |
|---|---|---|---|
| Eastern States | 246,673 | 3,449 | 250,122 |
| Central States | 423,246 | 127,215 | 550,461 |
| Pacific Coast States | [2] 23,952 | 42,864 | 66,816 |
| Total United States | 693,871 | 173,528 | 867,399 |

[1] Includes local deliveries.
[2] Includes 28 tons subsequently shipped from Seattle, Wash., by water to Alaska.

*Imports and exports.*[5]—In 1938 imports of fuel briquets rose to 13,814 net tons all from Belgium and the Netherlands, and all entering Massachusetts, Maine, and New Hampshire. Exports dropped to 16,692 tons, valued at $123,309, of which all but 2 tons went to Canada.

*Briquets (coal and coke) and other composition coals for fuels imported for consumption in the United States, 1934–38*

| Year | Net tons | Value | Year | Net tons | Value |
|---|---|---|---|---|---|
| 1934 | (1) | (1) | 1937 | 6,674 | $28,549 |
| 1935 | 16,779 | $73,992 | 1938 | 13,814 | 67,366 |
| 1936 | 20,350 | 80,210 | | | |

[1] None reported in 1934.

[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Briquets (coal and coke) exported from the United States, 1937–38, by countries and customs districts* [1]

| Country | 1937 | | 1938 | | Customs district | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|
| | Net tons | Value | Net tons | Value | | Net tons | Value | Net tons | Value |
| Canada | 25,123 | $164,357 | 16,690 | $123,278 | Buffalo | 19,210 | $120,711 | 11,832 | $87,170 |
| Cuba | 126 | 1,006 | ------ | ------ | Dakota | 195 | 1,967 | (2) | 10 |
| Guatemala | 2 | 40 | ------ | ------ | Duluth and Superior | 180 | 1,604 | 79 | 699 |
| Mexico | 30 | 359 | 2 | 31 | Maine and New Hampshire | ------ | ------ | 30 | 246 |
| United Kingdom | 69 | 607 | ------ | ------ | Maryland | 10 | 127 | ------ | ------ |
| | | | | | Massachusetts | (2) | 19 | ------ | ------ |
| | | | | | Michigan | 1,500 | 9,643 | 941 | 4,511 |
| | | | | | New Orleans | 204 | 1,837 | ------ | ------ |
| | | | | | New York | 11 | 30 | 1 | 38 |
| | | | | | St. Lawrence | 3,793 | 28,246 | 3,482 | 27,662 |
| | | | | | San Diego | 2 | 18 | 2 | 31 |
| | | | | | Washington | 245 | 2,167 | 325 | 2,942 |
| | 25,350 | 166,369 | 16,692 | 123,309 | | 25,350 | 166,369 | 16,692 | 123,309 |

[1] Exports not reported separately by Bureau of Foreign and Domestic Commerce prior to 1937.
[2] Less than 1 ton.

*World production.*—World data for 1938 are incomplete, but the available statistics, with virtually complete data for the preceding years, are given in the following table.

*World production of fuel briquets, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Algeria | 73,340 | 73,200 | 60,885 | 68,682 | (2) |
| Australia: Victoria [3] | 328,807 | 292,866 | 363,340 | 396,760 | 420,704 |
| Belgium | 1,353,530 | 1,368,610 | 1,559,890 | 1,849,280 | 1,702,470 |
| Bulgaria | 19,534 | 43,015 | 41,802 | 47,106 | 85,770 |
| Czechoslovakia: | | | | | |
| Coal | 386,463 | 408,539 | 414,896 | 459,680 | (2) |
| Lignite | 194,893 | 188,466 | 189,304 | 264,482 | (2) |
| Eire (Irish Free State) | (2) | (2) | 2,745 | 10,725 | (2) |
| France | 7,946,820 | 7,998,500 | 8,518,480 | 7,957,000 | (2) |
| Germany: [4] | | | | | |
| Coal | 5,193,279 | 5,567,508 | 6,044,310 | 6,785,537 | 6,897,245 |
| Lignite | 31,384,338 | 32,837,070 | 36,074,489 | 41,951,141 | 44,007,268 |
| Saar | 6,105 | (4) | (4) | (4) | (4) |
| Hungary: | | | | | |
| Coal | } 328,208 | 334,766 | 317,916 | 373,519 | (2) |
| Lignite | | | | | |
| Indochina | 62,231 | 71,118 | 104,644 | 132,225 | (2) |
| Italy | 18,290 | 38,710 | 46,533 | 58,860 | (2) |
| Netherlands: | | | | | |
| Coal | 1,087,145 | 1,087,349 | 1,119,585 | 1,277,305 | 1,262,716 |
| Lignite | 33,996 | 31,352 | 31,190 | 49,539 | 60,543 |
| Netherland India | 34,673 | 46,263 | 56,347 | 55,349 | (2) |
| New Zealand | 8,809 | 10,669 | 21,445 | 31,582 | (2) |
| Poland | 215,008 | 192,288 | 167,416 | 209,347 | 222,531 |
| Portugal [5] | [5] 311 | [5] 170 | [5] 850 | 7,772 | 19,865 |
| Rumania | 121,766 | 239,033 | 220,461 | 253,302 | (2) |
| Spain | 837,292 | 814,316 | (2) | (2) | (2) |
| Tunisia | 62,940 | 58,696 | 79,138 | 82,805 | (2) |
| Turkey | (2) | (2) | (2) | 14,761 | (2) |
| United Kingdom | 891,303 | 870,786 | 725,234 | 826,600 | 507,415 |
| United States | 639,431 | [6] 803,717 | [6] 1,080,814 | [6] 1,035,970 | [6] 936,402 |
| Yugoslavia | 23,533 | 18,365 | 13,350 | 61,323 | 100,945 |
| | [7] 51,252,045 | [7] 53,395,372 | [8] 57,255,064 | [9] 64,260,652 | (2) |

[1] In addition to the countries listed, briquets are produced in Canada and New Caledonia, but data of output are not available.
[2] Data not available.
[3] Data for year ended Mar. 31 of year stated.
[4] Beginning with March 1935, production of the Saar is included with that of Germany.
[5] From domestic coal only.
[6] Includes packaged fuel as follows: 1935, 22,901 tons; 1936, 60,261 tons; 1937, 132,482 tons; 1938, 146,012 tons.
[7] Exclusive of Eire (Irish Free State) and Turkey.
[8] Exclusive of Spain and Turkey.
[9] Exclusive of Spain.



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## PACKAGED FUEL

The production of packaged fuel continues to expand and apparently has definitely passed the pioneering stage. In 1938, 76 plants produced 160,952 tons valued at $1,405,253—three times as many active plants as in 1935 and nearly three times the value reported in 1936. The increase over 1937 was 14,915 tons (10 percent).

Of the 76 plants, 67 are in the Central States; Michigan, Ohio, Wisconsin, and Minnesota are the most important producing States.

Packaged fuel is manufactured principally for local or nearby consumption, but five operators, whose plants are located at docks on the Great Lakes, reported shipments by rail in 1938 of about 5,000 tons to points within a radius of 500 miles.

The National Association of Packaged Fuel Manufacturers held its second meeting in Chicago on September 15, 1938. A discussion of this meeting in Packaged Fuel News[6] stated that the technical problems confronting the industry have been largely overcome and that further expansion is expected through cooperation of its members in aggressive merchandising methods.

Numerous inquiries from foreign countries indicate interest in the manufacture of packaged fuel abroad. According to an established packaged-fuel machine manufacturer, however, difficulties in arranging for overseas shipment of machinery and other necessary supplies have interfered with the foreign sales of such equipment.

*Production and value.*—The following table summarizes the production and value received at the plant for the packaged fuel manufactured in the United States, 1937–38.

*Packaged fuel produced in the United States, 1937–38, by States*

[The plants and production reported in this table are not included in the preceding fuel-briquet tables]

| State | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Plants | Net tons | Value | Plants | Net tons | Value |
| Central States: | | | | | | |
| Idaho | 1 | (1) | (1) | 1 | (1) | (1) |
| Illinois | 5 | 3,153 | $31,820 | 5 | 4,133 | $42,555 |
| Indiana | 4 | 10,940 | 86,181 | 5 | 12,060 | 87,667 |
| Iowa | 1 | (1) | (1) | 2 | (1) | (1) |
| Michigan | 15 | 54,259 | 467,655 | 21 | 60,676 | 509,779 |
| Minnesota | 4 | 12,599 | 144,107 | 6 | 14,304 | 162,746 |
| Nebraska | 1 | (1) | (1) | 1 | (1) | (1) |
| Ohio | 18 | 30,873 | 250,826 | 17 | 31,522 | 256,489 |
| Wisconsin | 7 | 16,909 | 139,108 | 9 | 24,662 | 210,473 |
| Undistributed [2] | ------- | 7,781 | 75,980 | ------- | 4,959 | 49,880 |
| Total Central States | 56 | 136,514 | 1,195,677 | 67 | 152,318 | 1,319,589 |
| Eastern and Pacific Coast States [3] | [3] 8 | 9,523 | 91,643 | [4] 9 | 8,636 | 85,664 |
| Total United States | 64 | 146,037 | 1,287,320 | 76 | 160,952 | 1,405,253 |

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[2] Includes States entered as "(1)" above.
[3] Maine 2, Pennsylvania 1, Virginia 3, Oregon, 1, Washington 1.
[4] Maine 2, Pennsylvania 1, Virginia 4, Oregon, 1, Washington 1.

[6] Packaged Fuel News, October 1938 (published by the National Association of Packaged Fuel Manufacturers, Harry Turner, secretary, 700 Quincy St., Topeka, Kans.

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December and July, respectively, continue to be the high and low months of production in the packaged-fuel industry. In month to month comparisons, however, it should be remembered that a number of new plants started operating in the latter part of both 1937 and 1938.

*Monthly production of packaged fuel in the United States in 1937–38, in net tons*

| Month | 1937 | 1938 | Month | 1937 | 1938 |
|---|---|---|---|---|---|
| January | 15,344 | 22,095 | August | 2,131 | 2,252 |
| February | 15,076 | 17,124 | September | 10,377 | 13,198 |
| March | 16,439 | 15,710 | October | 21,164 | 19,671 |
| April | 15,286 | 13,673 | November | 21,976 | 23,271 |
| May | 4,321 | 7,074 | December | 22,253 | 25,323 |
| June | 972 | 789 | | | |
| July | 698 | 772 | | 146,037 | 160,952 |

The figures in the following table represent the value received per ton at the plant in the States for which this information can be shown separately. The values reported by the individual operators show a higher return per ton where considerable tonnage was sold in less than quarter-ton lots.

*Average value per net ton of packaged fuel sold in the United States, 1937–38, by States*

| State | 1937 | 1938 | State | 1937 | 1938 |
|---|---|---|---|---|---|
| Eastern States | $9.81 | $9.62 | Central States—Continued. | | |
| Central States: | | | Ohio | $8.12 | $8.14 |
| Illinois | 10.09 | 10.30 | Wisconsin | 8.23 | 8.53 |
| Indiana | 7.88 | 7.27 | Central States average | 8.76 | 8.66 |
| Michigan | 8.62 | 8.40 | Pacific Coast States | (1) | (1) |
| Minnesota | 11.44 | 11.38 | United States average | 8.82 | 8.73 |

[1] Bureau of Mines not at liberty to publish figures.

*Processes.*—Of the 76 operations in 1938, 72 used the Eberling process[7] described in previous reports of this series. The other four operations are outlined briefly in the following paragraphs.

The Johnson Coal Cubing Co.,[8] of Detroit, Mich., uses a process and equipment of its own design, producing a cube-shaped briquet wrapped in heavy paper, eight to the package. This company, which is the largest of the packaged-fuel operations, started production in 1932.

A new plant in Grand Rapids, Mich., reported the first installation of a machine that produces bricks (6½ by 3½ by 4 inches) which are hand-packed three to a paper bag and weigh 10 to 11 pounds.

A new plant in Minneapolis, Minn., which started operations late in 1938 with still another type of machine, uses asphalt binder instead of the cornstarch usually employed in the manufacture of packaged fuel. Eight 3-inch cubes to the package are automatically wrapped in heavy paper by a specially designed wrapping machine with a capacity of 40 packages per minute or 12 tons per hour.

[7] Packaged Fuel by the Eberling Process: 1938 catalog issued by C. M. Eberling, 6002 Ellen Avenue, Cleveland, Ohio.

[8] The Black Diamond, vol. 102, No. 7, Apr. 8, 1939, p. 23.

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A new plant operated by eight local coal yards in Fort Wayne, Ind., has installed a machine of the tamp type that produces 4-inch cubes, which are paper-wrapped, four to the package.

*Number of plants.*—Of the 76 active plants in 1938, 16 reported operations for the first time. All but one of the new plants are in the Central States region. Eight plants were idle in 1938; several of these found it more profitable to buy the packaged fuel from other manufacturers for resale. One company went out of business in 1938.

*Size of plants.*—Sixty-one of the 76 packaged-fuel plants active in 1938 produced less than 3,000 tons each during the year; 16 of these were new (of which five operated 12 months and 11 but a few months in 1938). Reports submitted on individual capacities indicate that the 76 plants were equipped to produce (if necessary to supply the demand) an annual total of about 500,000 tons.

*Classification of packaged-fuel plants in 1938, by size of output and annual capacity*

| Output (net tons) | Plants | Annual capacity (net tons) | Plants |
|---|---|---|---|
| Less than 500 | 17 | 2,000 and less than 5,000 | 38 |
| 500 and less than 1,000 | 14 | 5,000 and less than 10,000 | 26 |
| 1,000 and less than 3,000 | 30 | 10,000 and less than 15,000 | 6 |
| 3,000 and less than 5,000 | 10 | 15,000 and less than 25,000 | 2 |
| 5,000 and less than 10,000 | 3 | 30,000 and less than 40,000 | 3 |
| 10,000 and less than 25,000 | 1 | 40,000 and less than 60,000 | |
| 25,000 and over | 1 | 60,000 and over | 1 |
| | [1] 76 | | [1] 76 |

[1] 12 plants operated 12 months of the year; 49 plants, 6 to 11 months; and 15 plants, 1 to 5 months (11 of these new in 1938).

*Raw fuels.*—The tendency in 1937 toward the use of shipped-in slack from the mines and Lake docks as raw fuel in the manufacture of packaged fuel became more prevalent in 1938, when 46 out of 76 plants used shipped-in slack exclusively; 15 plants used both shipped-in slack and yard screenings and 12 plants yard screenings exclusively. Four operators did not reply to this question.

The principal raw fuel is bituminous low-volatile slack, which was used exclusively by 67 operators; 1 operator used bituminous high-volatile slack, 3 petroleum coke, 1 semianthracite, and several operators used mixtures of these various fuels.

*Binders.*—Cornstarches remain the principal binders used. Two operators reported using cement, one asphaltic pitch, and one glue.

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# PEAT

By F. M. Shore

SUMMARY OUTLINE


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The commercial production of peat and peat humus in the United States declined materially in 1938, according to reports courteously furnished by producers to the Bureau of Mines. The total production amounted to 45,933 short tons valued at producing plants at $286,127, a reduction of 10 percent in tonnage and 6 percent in value from 1937. Imports of peat moss also declined substantially in 1938 to 69,509 short tons valued at $1,092,942 as against 86,871 tons valued at $1,219,127 in 1937, a loss of 20 percent in quantity and 10 percent in value. The total quantity of peat and peat humus available for domestic consumption in 1938 (domestic production plus imports) was 115,442 short tons, a reduction of 16 percent from 1937. The downward trend in peat production in 1938 was in line with, but less than, the drop in industrial production generally. It will be noted, however, that the average value per ton of peat in 1938 was larger than in 1937, as well as that of peat-moss imports.

*Reserves.*—The total quantity of peat in the United States, exclusive of Alaska, calculated as air-dried peat, has been estimated at 13,827,000,000 short tons.[1] The area of the lands that contain peat deposits probably exceeds 100,000,000 acres. The bulk of the peat reserves is in the States of the Upper Lakes region—Minnesota, Wisconsin, and Michigan together having about 75 percent of the total. Substantial deposits of peat occur in other States bordering the Great Lakes and the Atlantic and Pacific coasts. About half the States contain some peat, but not all of the deposits can be developed economically.

The texture and quality of peat deposits and the value of the peat for specific uses may vary greatly because of different plant origins, conditions under which the deposits were formed, and stages of development. The various factors individual to each peat deposit, including its potential markets, character, and circumstances of deposition, must be studied carefully before its possibilities for profitable development can be determined.

*Production.*—Figure 1 shows the annual production of peat in the United States since the industry attained commercial importance.

The quantity and value of the domestic output of peat in recent years are given in the following table.

[1] Soper, E. K., and Osbon, C. C., The Occurrence and Uses of Peat in the United States: Geol. Survey Bull. 728, 1922, p. 92.



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*Peat produced in the United States, 1926 and 1934–38* [1]

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1926 | 61,936 | $364,413 | 1936 | 46,126 | $266,883 |
| 1934 | 40,544 | 214,185 | 1937 | 51,223 | 305,156 |
| 1935 | 37,060 | 199,377 | 1938 | 45,933 | 286,127 |

[1] No canvass 1927–33, inclusive.

Output of peat in 1938 was reported by 39 producers operating plants in 14 States. The same States produced peat in 1938 as in 1937, but there were three less producers. The 1938 production totaled 45,933 short tons valued at $286,127. In 1938, as in 1937, New York and New Jersey were the largest producing States. Other States reporting commercial production of peat, in order of output,

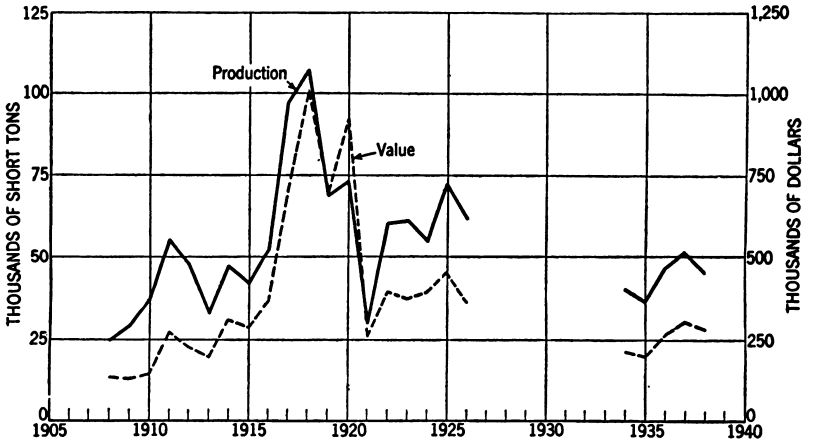


FIGURE 1.—Quantity and value of peat production, 1908–38. No data are available for the period 1927–33.

were Michigan, California, Florida, Ohio, Colorado, Minnesota, Iowa, Washington, Pennsylvania, New Hampshire, Maine, and Massachusetts. The production from some of these States was of little economic consequence, and the wide distribution of producing operations is more significant of the scope and potential value of peat resources and possible future markets than it is of present utilization. Approximately 58 percent of the production in 1938 was peat humus, about 32 percent reed and sedge peat, and the remainder moss and various other kinds of peat. Twelve States produced peat humus, five reed or sedge peat, and seven moss peat. Two plants reported the production of kiln-dried peat, 7 of cultivated peat, 27 of shredded peat, and 16 of raw peat.

The Bureau of Mines attempts to report only the commercial production of peat; however, this tonnage does not represent the total utilization of domestic peat in the United States. Some municipalities operate peat plants for their own needs, such as to improve the soils of lawns and parks, and many owners of land containing peat or muck soils use them for growing vegetables or other crops.

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Data showing the area of peat and muck soils under cultivation are not available, but the total amounts to many thousands of acres. It should be noted that such use of peat is an important factor in economic utilization of the national peat resources.

*Uses.*—Peat can be used for many purposes, but its use in this country is confined largely to improvement of soils, directly as a soil conditioner or an ingredient of fertilizers or indirectly as a compost with animal or vegetable refuse. The producers of peat were asked to report, in connection with their 1938 production, the quantity of peat sold for use in mixed fertilizers, but the reports were too incomplete to warrant publication. Peat is employed to some extent as a packing material for the shipment of plants, vegetables, fruits, or fragile articles and as an insulating material. Its chief use is for improving soils for growing vegetables, fruits, flowers, trees, shrubbery, and grass; in gardens, nurseries, and greenhouses; and on lawns, golf courses, and parks. The reports of peat and peat-humus sales in 1938 indicated that 76 percent was sold for soil improvement. Other uses reported were stable and poultry litter and packing material. In many European countries peat is used widely as a domestic fuel, and in some of them substantial quantities are used for industrial fuel. In the United States peat cannot compete under present conditions with high-grade fuels that are so widely available. No sales of domestic peat for fuel have been reported in recent years.

*Imports.*[2]—Imports of peat moss in 1938 decreased in total quantity and value from the 1937 record, although the average value per ton was greater than in 1937. The tonnage was 20 percent and the total value of imports 10 percent below 1937 figures. The chief sources of imports of peat moss in 1938 were, in order of tonnage, Germany, Sweden, the Netherlands, and Canada. Imports from Canada showed a substantial gain, continuing the upward trend that began in 1934.

Imports of peat moss into continental United States were received through 25 customs districts, indicating the wide geographical distribution of its use. Most of the imports (approximately 63 per cent) were received at Atlantic coast ports, although some 10,000 tons entered through Gulf ports and 14,000 tons through Pacific ports.

The average value per ton of peat-moss imports increased again in 1938, continuing a trend that has prevailed for several recent years. It was $10.74 in 1933, $12.40 in 1934, $12.42 in 1935, $12.73 in 1936, $14.03 in 1937, and $15.72 in 1938. The average value reported varies considerably with the country of origin. For example, imports from Canada in 1938 were $22.85 per ton, Latvia $21.30, Sweden $18.66, Germany $14.45, and the Netherlands $9.83.

*Peat moss imported for consumption in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 44,132 | $547,353 | 1937 | 86,871 | $1,219,127 |
| 1935 | 54,547 | 677,513 | 1938 | 69,509 | 1,092,942 |
| 1936 | 75,066 | 955,807 | | | |

[2] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Peat moss imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Belgium | 323 | $6,024 | | |
| Canada | 2,974 | 68,730 | 3,989 | $91,167 |
| Denmark | 1,009 | 16,839 | 1,239 | 17,293 |
| Estonia | 1,139 | 20,018 | 1,486 | 26,514 |
| Finland | | | 77 | 1,659 |
| Germany | 52,928 | 630,218 | 36,381 | 525,564 |
| Japan | 83 | 1,701 | | |
| Latvia | 1,414 | 23,582 | 1,604 | 34,166 |
| Netherlands | 5,018 | 65,501 | 6,709 | 65,968 |
| Norway | 968 | 18,604 | 744 | 13,325 |
| Poland and Danzig | | | 222 | 3,145 |
| Sweden | 19,058 | 338,962 | 15,127 | 282,234 |
| U. S. S. R. | 1,250 | 17,918 | 1,433 | 25,455 |
| United Kingdom | 707 | 11,030 | 498 | 6,402 |
| | 86,871 | 1,219,127 | 69,509 | 1,092,942 |

*World production.*—It is difficult to obtain comprehensive and current data regarding world production of peat. Apparently some peat-producing countries do not compile data showing the quantities produced, and the units of quantity used by countries that do report production are not uniform. The data in the following table, although not complete, will prove of interest to those concerned with the production and use of peat, as they represent the latest information now available.

*World production of peat in 1936, by countries*

[Compiled by M. T. Latus]

| Country | 1936 | Country | 1936 |
|---|---|---|---|
| Argentina—metric tons | (1) | Lithuania—metric tons | 124,000 |
| Austria—do | (1) | Netherlands—do | (1) |
| Canada (fuel)—do | 1,217 | Norway—do | (1) |
| Denmark—do | (1) | Poland—do | (1) |
| Eire—do | (2) | Sweden: | |
| Estonia—do | 106,659 | Fuel—do | 30,743 |
| Finland—do | (2) | Litter, baled—do | 109,349 |
| France—do | 17,050 | Litter and "mull," unbaled cubic meters | 37,067 |
| Germany—do | (1) | "Mull," baled—metric tons | 35,916 |
| Hungary—do | (1) | Switzerland—do | 7,000 |
| Italy—do | 3,194 | United States—do | 41,845 |
| Latvia: | | U. S. S. R.—do | [4] 22,286,000 |
| Litter—cubic meters | 46,127 | | |
| Waste—do | 15,876 | | |
| Insulation—do | 1,604 | | |

[1] Data not available.

[2] About 60 percent of the farmsteads in the country depend entirely on peat fuel, the annual consumption of which is estimated at 6 to 8 million tons. About 50,000 tons of peatmoss litter and peat mull are manufactured annually in Ireland, and some 10,000 tons of air-dried turf are used annually for power purposes. (The Mineral Position of the British Empire, London, 1937, p. 30.)

[3] 18,249 metric tons, 231,661 bales, and 8,201 cubic meters; equivalent in metric tons not available.

[4] Estimated.

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# CRUDE PETROLEUM AND PETROLEUM PRODUCTS [1]

By A. G. White, G. R. Hopkins, and H. A. Breakey

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The relative proportion contributed by the United States to world oil production fell from 62.7 percent in 1937 to 61.3 percent in 1938. The 1938 decline of 66 million barrels in United States crude oil production, owing to depressed domestic demand and efforts to reduce crude and refined stocks to more economic levels, was offset by an increase of only 2 million barrels for all other world producers combined. Consequently, total world production fell from 2,042 million barrels in 1937 to 1,978 million in 1938, a decrease of 64 million. Increases of 7 million barrels in Russian output, 4 million in Canada, and smaller gains in other producing countries were largely balanced by the decline of 12 million barrels in Mexican production that resulted from expropriation of oil properties by the Government and the decline of 4 million barrels in Rumanian output.

The total exports of crude and refined products from continental United States rose from 173 million barrels in 1937 to 194 million in 1938, while total imports fell from 57 to 54 million. This substantial gain in net exports was due in part to the accumulation of strategic stocks abroad.

The combined domestic and export demand for all oils in 1938 decreased about 14 million barrels from the 1937 all-time peak of 1,342 million. As exports of all oils increased 21 million barrels, domestic demand was reduced by 35 million barrels. A decline of 9 percent (30 million barrels) in the total demand for residual fuel oils was the major feature in 1938.

Although the drop in the total volume of the oil industry's business was only a little over 1 percent, slight progress was made in reducing

[1] Data for 1938 are preliminary; detailed statistics with final revisions will be released later.



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the excessive inventories accumulated in 1937, and prices of refined products trended steadily downward during the year, followed by a sharp break in crude prices in October. Many small refineries were closed when operations became unprofitable, and the net profits of many of the larger integrated companies were sharply reduced.

The following table shows the trend in the demand for all oils since 1929.

*Total demand for all oils, 1929–38*

[Millions of barrels]

| Year | Domestic demand | Exports | Total demand | Year | Domestic demand | Exports | Total demand |
|---|---|---|---|---|---|---|---|
| 1929 | 940.1 | 163.1 | 1,103.2 | 1934 | 920.2 | 114.5 | 1,034.7 |
| 1930 | 926.4 | 156.5 | 1,082.9 | 1935 | 983.7 | 129.0 | 1,112.7 |
| 1931 | 903.2 | 124.4 | 1,027.6 | 1936 | 1,092.7 | 132.0 | 1,224.7 |
| 1932 | 835.5 | 103.3 | 938.8 | 1937 | 1,169.7 | 172.8 | 1,342.5 |
| 1933 | 868.5 | 106.7 | 975.2 | 1938 [1] | 1,134.2 | 193.9 | 1,328.1 |

[1] Subject to revision.

The sharp, unexpected drop in the upward trend of demand in the last quarter of 1937 resulted in a rapid increase in total stocks that was augmented in the first quarter of 1938, before the domestic industry could adjust itself to the change in market demand. Subsequent efforts to reduce inventories to a more normal level represent a dominant factor in operations during the remainder of the year.

Stocks of all oils were reduced by 10 million barrels in 1938, representing a decline of 29 million barrels in crude stocks and an increase of 19 million barrels in refined stocks. The decrease in crude stocks was due to active proration control by various State conservation agencies in an effort to correct the excessive inventories of all oils. This effort was largely offset by refinery operations on a larger scale than was necessary to meet demand. The position of total stocks east of California was improved by a total reduction of 41 million barrels, of which 39 million represented crude oil and only 2 million refined oils. Total stocks of California oils increased by 31 million barrels, of which 10 million represented crude oil and 21 million, refined products.

*Salient statistics of crude petroleum, refined products, and natural gasoline, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Crude petroleum: | | | | | |
| Domestic production—thousands of barrels [2] | 908,065 | 996,596 | 1,099,687 | 1,279,160 | 1,213,254 |
| World production—do | 1,521,474 | 1,654,951 | 1,804,925 | 2,041,715 | 1,978,340 |
| United States proportion of world production—percent | 60 | 60 | 61 | 63 | 61 |
| Imports [3]—thousands of barrels [3] | 35,558 | 32,239 | 32,327 | 27,484 | 26,412 |
| Exports [4]—do | 41,127 | 51,430 | 50,313 | 67,234 | 77,273 |
| Stocks, end of period: | | | | | |
| Refinable crude—do | [5] 337,254 | [5] 314,855 | [5] 288,579 | {[5] 306,826 / [6] 305,091} | 274,353 |
| California heavy crude—do | (7) | (7) | (7) | 14,505 | 16,467 |
| Runs to stills—do | 895,636 | 965,790 | 1,068,570 | 1,183,440 | 1,165,015 |
| Total value of domestic production at wells—thousands of dollars | 904,825 | 961,440 | 1,199,820 | 1,513,340 | 1,390,000 |
| Average price per barrel at wells | $1.00 | $0.97 | $1.09 | $1.18 | $1.15 |
| Total producing oil wells in the United States, Dec. 31 | 333,070 | 340,990 | 349,450 | 363,030 | (7) |
| Total oil wells completed in the United States during year | 12,512 | 15,108 | 17,800 | 22,143 | 19,121 |

See footnotes at end of table.

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*Salient statistics of crude petroleum, refined products, and natural gasoline, 1934–38*—Continued

| | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Refined products: | | | | | |
| Imports [4]—thousands of barrels [2] | 14,936 | 20,396 | 24,777 | 29,673 | 27,736 |
| Exports [4]—do | 73,380 | 77,557 | 81,681 | 105,600 | 116,633 |
| Stocks, end of period—do | [5] 222,682 | [5] 223,361 | [5] 226,595 | [6] 253,413<br>[6] 239,632 | 259,613 |
| Output of motor fuel—do | 423,801 | 468,021 | 516,266 | 571,727 | 567,905 |
| Yield of gasoline—percent | 43.4 | 44.2 | 44.1 | 43.9 | 44.3 |
| Completed refineries, end of year | 631 | 632 | 572 | 551 | [7] |
| Daily crude-oil capacity of refineries—thousands of barrels [3] | 4,059 | 4,117 | 4,295 | 4,351 | [7] |
| Average tank-wagon price (excluding tax) of gasoline in 50 United States cities—cents per gallon [8] | 12.26 | 12.02 | 12.63 | [9] 10.53 | [9] 10.43 |
| Natural gasoline: | | | | | |
| Production—thousands of barrels [2] | 36,556 | 39,333 | 42,770 | 49,177 | 50,317 |
| Stocks, end of period—do | 4,216 | 3,698 | 4,055 | 4,758 | 4,830 |

[1] Subject to revision.
[2] 42 gallons.
[3] As reported to the Bureau of Mines.
[4] Bureau of Foreign and Domestic Commerce; exports include shipments to Alaska, Hawaii, and Puerto Rico.
[5] California heavy crude and fuel oil included under refined products.
[6] For comparison with succeeding year.
[7] Figures not available.
[8] American Petroleum Institute.
[9] Dealer's net. Comparable tank-wagon prices are no longer available.

There was virtually no change in the demand for foreign crude petroleum, as runs to stills remained the same in spite of a decline in imports.

The total demand for domestic crude in 1938 fell 20 million barrels from that of the previous year. An increase of 10 million barrels in exports indicated a decline of 30 million barrels in the internal demand for domestic crude. This amount represented a decrease in 1938 of about 18 million barrels in runs to stills and of 12 million in crude used for fuel and losses. The recession in the latter item may have been due to substantial reductions in the price of residual fuel oil, while the price of crude oils remained unchanged until late in the year.

With a decline of 66 million barrels in the total production of crude petroleum in the United States, the relative position of the States producing over 10 million barrels changed extensively in 1938. Texas, California, and Oklahoma continued to rank as the three leading producers, but their percentage of the total fell from 76 percent in 1937 to 74 percent in 1938. Production in Texas decreased 35 million and in Oklahoma 54 million barrels, and production in California increased 11 million. The increase of 16 million barrels in Illinois production raised the rank of the State from eleventh in 1937 to seventh in 1938.

The more important trends of the year are indicated by a brief analysis of major operations by quarters.

During the first quarter of 1938 total demand for all oils was about 1 percent greater than for the same period in 1937. Actually, this represented a figure far below expectations, with the result that production and refinery operations exceeded requirements, and about 5 million barrels were added to crude stocks and 18 million to refined stocks. By the end of March stocks of finished and unfinished gasoline had reached an all-time record of over 92 million barrels. The demand for residual fuel oil was 12 percent below that in the first quarter of

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1937, and the demand for gas and distillate fuels was virtually unchanged. The situation was improved somewhat by a gain over the same period in 1937 of 7 million barrels in crude exports.

In the second quarter of 1938 compared to the same period of 1937 the demand for all oils declined by 8 million barrels and stocks of all oils were reduced 15 million barrels, mostly crude. The domestic demand for motor fuel dropped 1 million barrels but was offset by a gain of 3 million in exports. The total demand for residual fuel oils declined 15 percent from 1937.

In the third quarter the demand for all oils was 16 million barrels less than for the same period in 1937. Stocks of crude oil were reduced by over 10 million barrels, while stocks of other products increased about 3 million. The total demand for motor fuel was about 3 million barrels less than in 1937, unfavorable weather conditions in July and September being an important factor. The demand for residual fuel oils was still 12 percent below that of the previous year.

In the fourth quarter of 1938 the demand for all oils was 7 million barrels greater than for the same period in 1937. Although part of this increase may be due to the fact that a sharp downward trend was evident in that period in 1937, it also is evidence of the beginning of a substantial improvement in the trend of demand in 1938. Total stocks of all oils decreased 21 million barrels during the quarter, of which 9 million represented crude and 12 million, other oils. Total motor fuel demand was 8 million barrels greater than in 1937, an increase of 5 million in domestic demand, partly due to favorable weather conditions, and of 3 million in exports. As compared to 1937, increased demand and restricted refinery operations resulted in a substantial improvement in the position of gasoline stocks. The demand for residual fuel oils rose 3 percent, and there was a substantial decrease in residual stocks. The improved trend of demand in this quarter continued in the early part of 1939.

In reviewing the demand for particular products in 1938, the outstanding features were a moderate increase in total motor-fuel demand, a sharp reduction in the demand for residual fuel oils, a stationary market for gas and distillate fuel oils and kerosene, and a decline in the demand for lubricants.

The total demand for motor fuel attained a new record of 572 million barrels in 1938, a gain of 14 million from 1937. Larger exports accounted for 12 million barrels of the increase, while domestic demand was only 2 million greater. The gain of about 14 million barrels of finished and unfinished gasoline stocks in 1937 was only partly offset by a decline of 5 million in 1938. High inventories combined with the modest increase in demand created an unstable price situation throughout the year, resulting in unprofitable refinery operations in many districts. The yield of gasoline from crude rose from 43.9 percent in 1937 to 44.3 percent in 1938, due in part to the adoption of improved refinery methods of recovery and in part to the combination of larger runs than necessary, with a weak market for residual fuel oils.

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The total demand for residual fuel oils in 1938 decreased over 30 million barrels from 1937. As exports increased by almost 3 million barrels, this loss was entirely in the domestic market. Stocks of residual fuel oils increased by 16 million barrels during 1938, a gain of 17 million barrels in California and a decline of 1 million in the districts east of California. The large increase in California stocks was due to excess production of crude oil that was run to stills, with a corresponding production of refined products above market demand. In the area east of California very little progress was made in liquidating the large excess of residual stocks accumulated in 1937. However, improved industrial demand, combined with lower prices for residual fuel in the last quarter of 1938 and the first quarter of 1939, promised to reduce these excessive inventories in the central and eastern districts.

The total demand for gas oil and distillate fuel oils in 1938 was virtually the same as in 1937, both for domestic demand and export. The year ended with an increase of 5 million barrels in inventories. A considerable part of this increase represented the return of California stocks to a more normal position. Comparatively mild weather in the first and fourth quarters of 1938 reduced the expected increase in the demand for heating oils, while transportation and industrial requirements were generally reduced by less favorable industrial conditions.

The total demand for kerosene in 1938 was practically the same as in 1937, with a gain of about 1 million barrels in domestic demand and a corresponding decrease in exports.

The total demand for lubricants was 11 percent less than in 1937. Domestic demand declined by 2 million barrels in 1938, while exports also decreased.

The long-term trends in supply and demand are shown in figure 1.

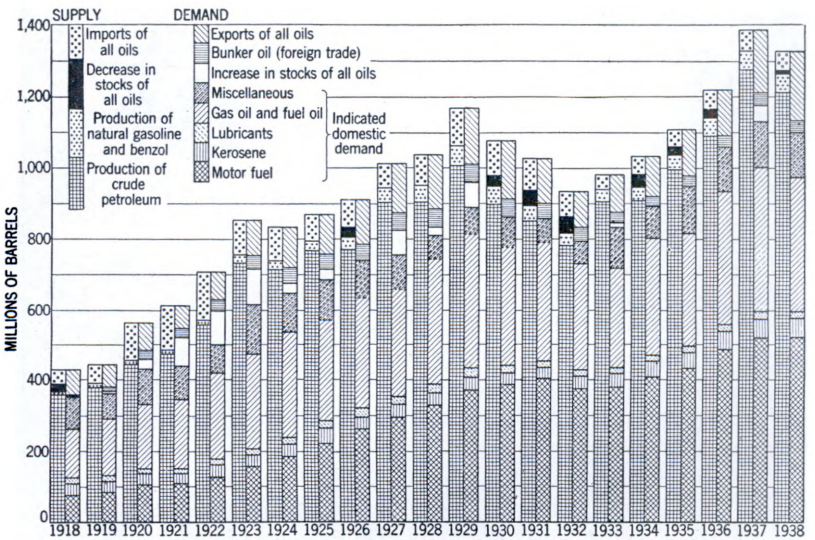


FIGURE 1.—Supply and demand of all oils, 1918–38.

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## *Supply and demand of all oils in 1938, by months*

[Including wax, coke, and asphalt in thousands of barrels]

| | 1938[1] | | | | | | | | | | | | | 1937 (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total | |
| New supply: | | | | | | | | | | | | | | |
| Domestic production: | | | | | | | | | | | | | | |
| Crude petroleum | 106,007 | 94,662 | 106,524 | 102,702 | 98,674 | 94,277 | 102,898 | 106,165 | 98,661 | 101,830 | 98,567 | 102,287 | 1,213,254 | 1,279,160 |
| Daily average | 3,420 | 3,381 | 3,436 | 3,423 | 3,183 | 3,143 | 3,319 | 3,425 | 3,289 | 3,285 | 3,286 | 3,300 | 3,324 | 3,505 |
| Natural gasoline | 4,336 | 3,889 | 4,326 | 4,171 | 4,196 | 4,001 | 4,127 | 4,226 | 4,081 | 4,375 | 4,244 | 4,345 | 50,317 | 49,177 |
| Benzol | 147 | 132 | 143 | 128 | 117 | 105 | 114 | 133 | 144 | 169 | 181 | 186 | 1,699 | 2,790 |
| Total production | 110,490 | 98,683 | 110,993 | 107,001 | 102,987 | 98,383 | 107,139 | 110,524 | 102,886 | 106,374 | 102,992 | 106,818 | 1,265,270 | 1,331,127 |
| Daily average | 3,564 | 3,524 | 3,580 | 3,567 | 3,322 | 3,279 | 3,456 | 3,565 | 3,430 | 3,431 | 3,433 | 3,446 | 3,466 | 3,647 |
| Imports:[2] | | | | | | | | | | | | | | |
| Crude petroleum | 2,095 | 1,883 | 2,569 | 1,827 | 2,081 | 2,192 | 2,565 | 1,714 | 1,574 | 2,693 | 2,359 | 2,860 | 26,412 | 27,484 |
| Refined products | 2,122 | 1,679 | 2,325 | 2,361 | 1,940 | 2,559 | 2,203 | 2,953 | 2,676 | 2,148 | 2,264 | 2,506 | 27,736 | 29,673 |
| Total new supply, all oils | 114,707 | 102,245 | 115,887 | 111,189 | 107,008 | 103,134 | 111,907 | 115,191 | 107,136 | 111,215 | 107,615 | 112,184 | 1,319,418 | 1,388,284 |
| Daily average | 3,700 | 3,652 | 3,738 | 3,706 | 3,452 | 3,438 | 3,610 | 3,716 | 3,571 | 3,588 | 3,587 | 3,619 | 3,615 | 3,804 |
| Change in stocks, all oils | +11,293 | +7,300 | +5,650 | +3,891 | −1,651 | −6,962 | +463 | −4,711 | −3,305 | −5,926 | −6,994 | −7,771 | −8,723 | +45,768 |
| Demand: | | | | | | | | | | | | | | |
| Total demand | 103,414 | 94,945 | 110,237 | 107,298 | 108,659 | 110,096 | 111,444 | 119,902 | 110,441 | 117,141 | 114,609 | 119,955 | 1,328,141 | 1,342,516 |
| Daily average | 3,336 | 3,391 | 3,556 | 3,577 | 3,505 | 3,670 | 3,595 | 3,868 | 3,681 | 3,779 | 3,820 | 3,870 | 3,639 | 3,678 |
| Exports:[2] | | | | | | | | | | | | | | |
| Crude petroleum | 5,953 | 5,328 | 6,121 | 7,553 | 7,798 | 7,424 | 7,250 | 7,003 | 5,577 | 6,780 | 5,602 | 4,884 | 77,273 | 67,234 |
| Refined products | 7,988 | 8,605 | 9,204 | 10,427 | 10,681 | 10,338 | 10,054 | 10,763 | 9,487 | 9,388 | 8,461 | 11,237 | 116,633 | 105,600 |
| Domestic demand: | | | | | | | | | | | | | | |
| Motor fuel | 35,176 | 31,861 | 41,259 | 43,254 | 44,911 | 48,293 | 47,474 | 50,459 | 46,058 | 46,272 | 44,991 | 41,649 | 521,657 | 519,352 |
| Kerosene | 5,360 | 5,017 | 5,150 | 4,333 | 3,637 | 3,257 | 3,752 | 4,292 | 4,187 | 5,185 | 5,368 | 6,813 | 56,351 | 54,972 |
| Gas oil and distillate fuel oils | 12,642 | 11,651 | 10,487 | 7,800 | 7,050 | 5,490 | 7,863 | 7,737 | 8,627 | 10,089 | 11,472 | 15,656 | 116,564 | 116,841 |
| Residual fuel oils | 25,844 | 23,627 | 25,696 | 22,279 | 22,447 | 22,278 | 20,548 | 23,775 | 23,082 | 25,666 | 27,621 | 29,787 | 292,650 | 325,514 |
| Lubricants | 1,471 | 1,311 | 2,195 | 1,591 | 1,730 | 1,606 | 1,844 | 2,002 | 2,127 | 1,805 | 1,735 | 1,831 | 21,248 | 23,323 |
| Wax | 115 | 82 | 90 | 101 | 92 | 85 | 75 | 81 | 69 | 72 | 71 | 61 | 994 | 1,062 |
| Coke | 535 | 416 | 308 | 313 | 422 | 573 | 445 | 473 | 636 | 442 | 520 | 506 | 5,589 | 5,765 |
| Asphalt | 1,077 | 883 | 1,444 | 1,654 | 2,203 | 2,675 | 2,799 | 3,201 | 3,017 | 2,701 | 1,745 | 1,132 | 24,531 | 21,876 |
| Road oil | 151 | 168 | 131 | 208 | 593 | 1,274 | 1,469 | 1,581 | 1,098 | 706 | 222 | 174 | 7,775 | 7,954 |
| Still gas (production) | 4,937 | 4,428 | 4,901 | 5,073 | 5,542 | 5,387 | 5,730 | 5,753 | 5,287 | 5,356 | 5,083 | 4,933 | 62,410 | 64,218 |
| Miscellaneous oils | 137 | 132 | 137 | 166 | 143 | 157 | 177 | 158 | 131 | 149 | 144 | 145 | 1,776 | 2,249 |
| Losses and crude as fuel | 2,028 | 1,436 | 3,114 | 2,546 | 1,410 | 1,259 | 1,964 | 2,624 | 1,058 | 2,530 | 1,574 | 1,147 | 22,690 | 26,556 |
| Total domestic demand | 89,473 | 81,012 | 94,912 | 89,318 | 90,180 | 92,334 | 94,140 | 102,136 | 95,377 | 100,973 | 100,546 | 103,834 | 1,134,235 | 1,169,682 |
| Daily average | 2,886 | 2,893 | 3,062 | 2,977 | 2,909 | 3,078 | 3,037 | 3,295 | 3,179 | 3,257 | 3,351 | 3,349 | 3,108 | 3,205 |
| Stocks, all oils | 575,279 | 582,579 | 588,229 | 592,120 | 590,469 | 583,507 | 583,970 | 579,259 | 575,954 | 570,028 | 563,034 | 555,263 | 555,263 | 564,997 |

[1] Subject to revision. [2] Imports of crude petroleum as reported to Bureau of Mines; all other imports and exports from Bureau of Foreign and Domestic Commerce.

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## RESERVES

The proved oil reserves of the United States were estimated at 17,348 million barrels as of January 1, 1939, in a report prepared by the Committee on Petroleum Reserves of the American Petroleum Institute. This estimate may be subject to later revision. It presents only the amount of crude oil that may be extracted by present known methods from fields completely developed or drilled or sufficiently explored to permit reasonably accurate calculations. The following table shows the previous estimates of reserves made by this committee, the figures for January 1, 1935, 1937, and 1938, being final and those for 1939 preliminary, subject to later revision.

*Estimates of proved oil reserves in the United States, on January 1, 1935 and 1937–39, by States* [1]

[Millions of barrels]

| State | 1935 [2] | 1937 [2] | 1938 [2] | 1939 [3] |
|---|---|---|---|---|
| Eastern States: | | | | |
| Illinois | 37 | 28 | 59 | 243 |
| Indiana | 5 | 3 | 7 | 6 |
| Kentucky | 50 | 39 | 38 | 38 |
| Michigan | 64 | 63 | 46 | 43 |
| New York | 75 | 66 | 45 | 40 |
| Ohio | 40 | 32 | 30 | 26 |
| Pennsylvania | 340 | 307 | 218 | 200 |
| West Virginia | 40 | 32 | 28 | 25 |
| | 651 | 570 | 471 | 621 |
| Central and Southern States: | | | | |
| Arkansas | 103 | 87 | 171 | 188 |
| Kansas | 390 | 590 | 607 | 613 |
| Louisiana | 513 | 657 | 1,049 | 1,040 |
| New Mexico | 451 | 581 | 739 | 703 |
| Oklahoma | 1,235 | 1,384 | 1,311 | 1,163 |
| Texas | 6,643 | 8,343 | 9,692 | 9,448 |
| | 9,335 | 11,642 | 13,569 | 13,155 |
| Mountain States: | | | | |
| Colorado | 16 | 19 | 19 | 18 |
| Montana | 102 | 115 | 109 | 104 |
| Wyoming | 267 | 260 | 280 | 261 |
| | 385 | 394 | 408 | 383 |
| Pacific Coast States: California | 3,261 | 3,251 | 3,303 | 3,189 |
| Total United States | 13,632 | 15,857 | 17,751 | 17,348 |

[1] From reports of Committee on Petroleum Reserves, American Petroleum Institute.
[2] Final revised estimates of the amount of crude oil which may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations.
[3] Subject to revision.

## LEGISLATION AND PRORATION

In 1938, as in 1936 and 1937, State and Federal regulation, including taxes, on petroleum maintained the "status quo." Most of the State legislation was routine in character, and no additions were made to the ranks of the prorating States or to the Interstate Oil Compact. The principal functions of the Federal Government in regulation of public lands continued to be those relating to the Connally Law. Several taxes of the Federal Government were not renewed.

The Bureau of Mines forecasts of demand by States were issued monthly throughout the year. As indicated in the table, actual production for the United States averaged about 60,000 barrels less than

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the estimates of demand. Crude-oil stocks were drawn on about 85,000 barrels daily, hence the actual demand for crude oil ran about 25,000 barrels daily, or less than 1 percent above the Bureau's estimates. The Bureau's record in estimating gasoline demand in 1938 was even better, the margin of error being less than one-half of 1 percent.

*State allowables and Bureau of Mines estimates of market demand,[1] compared with actual production in the United States, in 1938*

[Daily averages, in thousands of barrels]

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Texas: | | | | | | | | | | | | |
| State allowable [2] | 1,331 | 1,273 | 1,342 | 1,366 | 1,220 | 1,206 | 1,386 | 1,443 | 1,260 | 1,309 | 1,311 | 1,325 |
| Bureau of Mines estimate | 1,351 | 1,366 | 1,345 | 1,330 | 1,323 | 1,329 | 1,360 | 1,378 | 1,399 | 1,359 | 1,371 | 1,344 |
| Actual production | 1,318 | 1,273 | 1,339 | 1,351 | 1,216 | 1,212 | 1,365 | 1,412 | 1,261 | 1,282 | 1,295 | 1,307 |
| Oklahoma: | | | | | | | | | | | | |
| State allowable [3] | 550 | 500 | 475 | 475 | 423 | 405 | 428 | 428 | 428 | 428 | 428 | 428 |
| Bureau of Mines estimate | 567 | 570 | 548 | 527 | 510 | 508 | 518 | 530 | 528 | 524 | 515 | 501 |
| Actual production | 562 | 535 | 526 | 505 | 464 | 431 | 450 | 471 | 469 | 454 | 441 | 446 |
| California: | | | | | | | | | | | | |
| State allowable [4] | 678 | 694 | 695 | 699 | 620 | 620 | 620 | 615 | 615 | 615 | 615 | 615 |
| Bureau of Mines estimate | 678 | 694 | 695 | 699 | 668 | 650 | 642 | 649 | 638 | 619 | 617 | 590 |
| Actual production | 710 | 736 | 724 | 722 | 689 | 672 | 661 | 670 | 664 | 659 | 663 | 646 |
| Kansas: | | | | | | | | | | | | |
| State allowable [5] | 186 | 182 | 183 | 184 | 160 | 168 | 171 | 168 | 163 | 161 | 162 | 162 |
| Bureau of Mines estimate | 179 | 176 | 177 | 173 | 169 | 172 | 172 | 169 | 168 | 163 | 164 | 159 |
| Actual production | 183 | 171 | 171 | 170 | 153 | 157 | 157 | 167 | 161 | 156 | 157 | 156 |
| Louisiana: | | | | | | | | | | | | |
| State allowable [6] | 256 | 245 | 247 | 252 | 251 | 250 | 250 | 257 | 260 | 260 | 236 | 248 |
| Bureau of Mines estimate | 238 | 239 | 239 | 240 | 243 | 250 | 261 | 256 | 255 | 248 | 256 | 248 |
| Actual production | 253 | 258 | 259 | 257 | 257 | 261 | 264 | 260 | 265 | 272 | 256 | 255 |
| New Mexico: | | | | | | | | | | | | |
| State allowable [7] | 105 | 101 | 101 | 106 | 97 | 91 | 102 | 107 | 106 | 105 | 106 | 98 |
| Bureau of Mines estimate | 103 | 105 | 105 | 106 | 104 | 108 | 113 | 112 | 112 | 109 | 111 | 100 |
| Actual production | 105 | 104 | 102 | 98 | 93 | 87 | 94 | 96 | 96 | 100 | 103 | 98 |
| Arkansas: | | | | | | | | | | | | |
| State allowable [8] | 40 | 47 | 50 | 55 | 41 | 45 | 53 | 55 | 56 | 51 | 48 | 50 |
| Bureau of Mines estimate | 35 | 37 | 38 | 40 | 45 | 48 | 51 | 54 | 54 | 54 | 52 | 52 |
| Actual production | 42 | 48 | 50 | 53 | 41 | 42 | 54 | 55 | 57 | 52 | 49 | 50 |
| Other States: | | | | | | | | | | | | |
| Bureau of Mines estimate | 256 | 251 | 245 | 247 | 256 | 268 | 281 | 290 | 290 | 291 | 305 | 312 |
| Actual production | 247 | 256 | 265 | 267 | 270 | 281 | 274 | 294 | 316 | 310 | 322 | 342 |
| United States: | | | | | | | | | | | | |
| Bureau of Mines estimate | 3,407 | 3,438 | 3,392 | 3,362 | 3,318 | 3,333 | 3,398 | 3,438 | 3,444 | 3,367 | 3,391 | 3,306 |
| Actual production | 3,420 | 3,381 | 3,436 | 3,423 | 3,183 | 3,143 | 3,319 | 3,425 | 3,289 | 3,285 | 3,286 | 3,300 |

[1] Beginning November 1936, the State figures have been estimates of demand rather than required production as formerly; hence, in comparing the demand data with actual production due regard should be given to changes in stocks by States of origin. (Changes in stocks and demand are given elsewhere in this chapter.)
[2] Railroad Commission of Texas.
[3] Corporation Commission of Oklahoma. State allowable figures as shown do not include production permitted in accordance with "underage" and other special provisions of State orders.
[4] Central Committee of California Oil Producers.
[5] State Corporation Commission of Kansas.
[6] Department of Conservation, Louisiana. State allowable figures shown do not include production permitted under special orders of said Department.
[7] Oil Conservation Commission of New Mexico. State allowable figures as shown do not include production permitted in accordance with "underage" and other special provisions of State orders.
[8] Oil and Gas Commission.

## EMPLOYMENT AND LABOR PRODUCTIVITY

The Bureau of Mines canvass of workers in the oil fields indicated an average employment of 121,371 for 1937, or 7 percent above the revised figure of 113,839 for 1936. The factors responsible for this

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gain were essentially the same as those underlying the material gain in number of workers in 1936, namely, higher prices and better profits, increased drilling, more wells connected to lines, and higher production. The totals above include the average number of part-time workers, totaling 12,903 in 1936 and 12,321 in 1937. Probably many of the new full-time employees in 1937 were recruited from the ranks of the part-time workers. Scattered returns for 1938 indicate a decline in employment, and the total number of workers for that year may not exceed the total of about 114,000 for 1936.

More oil-field workers were employed in 1937 than in 1936 in the majority of the States, only Colorado, Indiana, Montana, Ohio, and West Virginia showing declines. The largest relative gain was in Illinois, where recently discovered fields gave employment to about 500 new wage earners.

*Employment at wells, crude petroleum produced, and average output per man in the United States, 1936–37, by States* [1]

| State | Average number of workers | | Crude petroleum production (thousands of barrels) | | Labor productivity (barrels per man-hour) | |
|---|---|---|---|---|---|---|
| | 1936 | 1937 | 1936 | 1937 | 1936 | 1937 |
| Arkansas | 1,794 | 1,940 | 10,469 | 11,764 | 2.75 | 2.79 |
| California | 18,073 | 19,640 | 214,773 | 238,521 | 6.76 | 6.68 |
| Colorado | [2] 126 | 110 | 1,650 | 1,605 | 6.25 | 7.20 |
| Illinois | 1,492 | 1,920 | 4,475 | 7,499 | 1.23 | 1.65 |
| Indiana | 244 | 230 | 822 | 844 | 1.78 | 1.91 |
| Kansas | 8,667 | 9,470 | 58,317 | 70,761 | 3.44 | 3.81 |
| Kentucky | 1,382 | 1,425 | 5,633 | 5,484 | 2.12 | 1.92 |
| Louisiana | 6,728 | 7,640 | 80,491 | 90,924 | 6.20 | 6.50 |
| Michigan | 1,150 | 1,705 | 11,928 | 16,628 | 5.38 | 4.67 |
| Montana | 598 | 590 | 5,868 | 5,805 | 5.07 | 4.94 |
| New Mexico | 1,155 | 1,190 | 27,223 | 38,854 | 13.49 | 16.07 |
| New York | 1,699 | 1,703 | 4,663 | 5,478 | 1.25 | 1.40 |
| Ohio | 2,442 | 2,350 | 3,847 | 3,559 | .88 | .81 |
| Oklahoma | 22,515 | 23,100 | 206,555 | 228,839 | 4.68 | 4.91 |
| Pennsylvania | 6,687 | 7,420 | 17,070 | 19,189 | 1.31 | 1.34 |
| Texas | 33,902 | 35,600 | 427,411 | 510,318 | 6.59 | 7.24 |
| West Virginia | 3,315 | 3,220 | 3,847 | 3,845 | .66 | .68 |
| Wyoming | 1,858 | 2,100 | 14,582 | 19,166 | 3.53 | 3.92 |
| Other States [3] | 12 | 18 | 63 | 77 | 2.86 | 2.41 |
| Total United States | [2] 113,839 | 121,371 | 1,099,687 | 1,279,160 | 5.04 | 5.33 |

[1] Figures for 1938 not yet available.
[2] Revised figures.
[3] Missouri, Tennessee, and Utah.

The average number of hours per week increased from 39.5 to 40.5 for the full-time workers, but the total hours of the part-time workers declined from an average of 835 in 1936 to 811 in 1937. Total man-hours increased from 217,988,000 in 1936 to 239,834,000 in 1937, a gain of 10 percent. Dividing total production by total man-hours gives labor-productivity averages of 5.04 barrels per man-hour in 1936 and 5.33 barrels in 1937. The gain is indicative of the extent to which technologic advances are outstripping increasing physical difficulties.

## CRUDE PETROLEUM

### SUPPLY AND DEMAND

Although production declined 5 percent in 1938 from 1937 the total demand for crude oil decreased less than 20,000,000 barrels, or about 1.5 percent. As imports of crude oil were about the same in the 2



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years, the statistical explanation lies in the trend of crude-oil stocks, which in 1938 were reduced about 29,000,000 barrels compared with a gain of about 18,000,000 barrels in 1937. Actually, the decline in real demand for crude oil in 1938 was less than is indicated above (1.5 percent), as the increase in refined inventories in 1938, while substantial, was less than in 1937.

The demand for heavy crude oil as fuel without refining declined materially, following the general stagnation of the fuel-oil market, but this loss of business was more than offset by a 10,000,000-barrel increase in exports.

*Supply of and demand for crude petroleum, 1934–38*

[Thousands of barrels]

| | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Production | 908,065 | 996,596 | 1,099,687 | 1,279,160 | 1,213,254 |
| Imports [2] | 35,558 | 32,239 | 32,327 | 27,484 | 26,412 |
| Changes in stocks east of California and in stocks of California light crude | −16,969 | −22,399 | −26,276 | +18,247 | [3] −28,776 |
| Total demand | 960,592 | 1,051,234 | 1,158,290 | 1,288,397 | 1,268,442 |
| Runs to stills: | | | | | |
| Domestic | 860,776 | 933,659 | 1,034,637 | 1,157,444 | 1,138,828 |
| Foreign | 34,860 | 32,131 | 33,933 | 25,996 | 26,187 |
| Exports [4] | 41,127 | 51,430 | 50,313 | 67,234 | 77,273 |
| Transfers to fuel-oil stocks in California | 8,382 | 13,067 | 15,732 | 17,423 | 10,660 |
| Consumed as fuel on producing properties [5] | 1,523 | 1,338 | 1,664 | 1,308 | |
| Consumed as fuel in operation of pipe lines [5] | 1,835 | 1,931 | 2,138 | 2,178 | 15,494 |
| Other fuel and losses | 12,089 | 17,678 | 19,873 | 16,814 | |
| Total demand | 960,592 | 1,051,234 | 1,158,290 | 1,288,397 | 1,268,442 |

[1] Subject to revision.
[2] As reported to the Bureau of Mines.
[3] Includes California heavy crude.
[4] Includes shipments to Alaska, Hawaii, and Puerto Rico.
[5] East of California.

## PRODUCTION

As shown in figure 2, the general trend of crude-oil production in 1938 was downward, as the fact gradually dawned that demand would be less than in 1937 and as proration restrictions were accordingly tightened. More specifically, the fluctuations in the trend correlate closely with the Saturday and Sunday shut-downs in Texas. The Sunday shut-downs, instituted January 23, 1938, were instrumental principally in preventing production from rising much above the 3,400,000-barrel mark; but the Saturday shut-downs, first added on May 14 and in effect over most of the remainder of the year, reduced production to below 3,300,000 barrels. Most of the other States with regulatory bodies assisted in the curtailment program, the decline in Oklahoma more than offsetting the gain in Illinois.

Texas continued to produce more than California and Oklahoma combined, but its proportion of the national total declined from 39.9 percent in 1937 to 39.2 in 1938. California's share increased materially, but Oklahoma's percentage in 1938 (14.4) was the lowest since 1906, when the State was coming into prominence. The most notable

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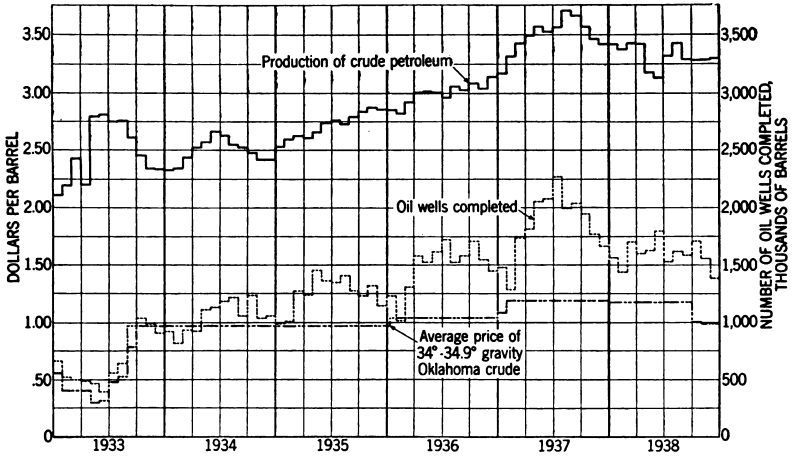


FIGURE 2.—Daily average production of crude petroleum, total number of oil wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum, 1933–38, by months.

increase of any State in 1938 was made by Illinois, whose percentage rose from 0.6 in 1937 to 2.0 in 1938.

The relative rank of the producing States is shown graphically in figure 3.

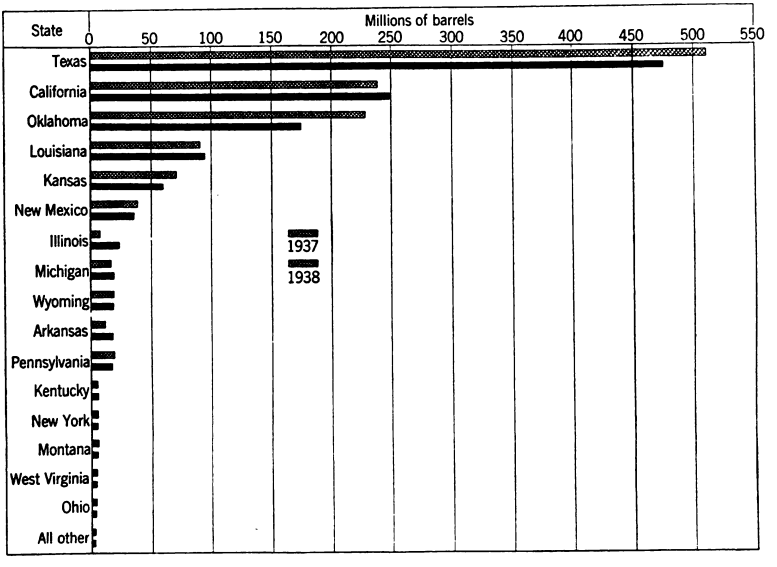


FIGURE 3.—Production of crude petroleum, 1937–38, by States.

Although output in the majority of the producing districts increased in 1938, these gains were far outweighed by the decline in the Mid-Continent. The district with the most notable series of gains is the Gulf Coast, which has increased steadily in output since 1932.

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*Production of crude petroleum in the United States in 1938, by districts, States, and months*

[Thousands of barrels]

| District and State | 1938 [1] | | | | | | | | | | | | | 1937 (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | January | February | March | April | May | June | July | August | September | October | November | December | Total | |
| **DISTRICT** | | | | | | | | | | | | | | |
| Pennsylvania grade | 2,394 | 2,267 | 2,555 | 2,344 | 2,386 | 2,276 | 2,184 | 2,314 | 2,189 | 2,198 | 2,056 | 2,153 | 27,316 | 29,862 |
| Other Appalachian (including Kentucky) | 534 | 532 | 601 | 561 | 593 | 623 | 636 | 696 | 681 | 657 | 689 | 654 | 7,407 | 7,102 |
| Lima-Northeastern Indiana-Michigan | 1,599 | 1,465 | 1,660 | 1,701 | 1,760 | 1,691 | 1,679 | 1,526 | 1,679 | 1,724 | 1,667 | 1,643 | 19,794 | 17,272 |
| Illinois-Southwestern Indiana | 1,194 | 1,178 | 1,403 | 1,461 | 1,518 | 1,546 | 1,729 | 2,154 | 2,642 | 2,854 | 3,150 | 4,069 | 24,898 | 8,325 |
| North Louisiana and Arkansas | 3,713 | 3,591 | 4,022 | 3,987 | 3,742 | 3,673 | 4,181 | 4,256 | 4,091 | 4,016 | 3,647 | 3,795 | 46,714 | 40,647 |
| West Texas and Southeastern New Mexico | 9,049 | 8,048 | 9,356 | 8,798 | 8,561 | 8,203 | 9,418 | 9,674 | 8,755 | 9,373 | 9,302 | 9,524 | 108,061 | 114,209 |
| East Texas | 14,426 | 12,146 | 13,738 | 13,244 | 11,900 | 11,376 | 13,530 | 14,062 | 11,669 | 12,238 | 11,678 | 12,136 | 152,143 | 170,673 |
| Oklahoma, Kansas, North Texas, etc | 34,339 | 29,913 | 33,405 | 31,916 | 30,167 | 28,289 | 30,805 | 32,094 | 29,749 | 30,046 | 28,993 | 30,292 | 370,008 | 448,840 |
| Gulf Coast | 14,761 | 13,141 | 15,296 | 15,006 | 14,579 | 14,105 | 15,964 | 16,226 | 14,997 | 16,091 | 15,425 | 15,887 | 181,478 | 176,743 |
| Rocky Mountain | 1,990 | 1,773 | 2,047 | 2,037 | 2,121 | 2,325 | 2,278 | 2,393 | 2,287 | 2,210 | 2,126 | 2,099 | 25,686 | 26,966 |
| California | 22,008 | 20,608 | 22,441 | 21,647 | 21,347 | 20,170 | 20,494 | 20,770 | 19,922 | 20,423 | 19,884 | 20,035 | 249,749 | 238,521 |
| Total United States | 106,007 | 94,662 | 106,524 | 102,702 | 98,674 | 94,277 | 102,898 | 106,165 | 98,661 | 101,830 | 98,567 | 102,287 | 1,213,254 | 1,279,160 |
| **STATE** | | | | | | | | | | | | | | |
| Arkansas | 1,286 | 1,335 | 1,562 | 1,576 | 1,277 | 1,272 | 1,680 | 1,718 | 1,721 | 1,624 | 1,470 | 1,556 | 18,077 | 11,764 |
| California | 22,008 | 20,608 | 22,441 | 21,647 | 21,347 | 20,170 | 20,494 | 20,770 | 19,922 | 20,423 | 19,884 | 20,035 | 249,749 | 238,521 |
| Colorado | 114 | 104 | 116 | 132 | 142 | 135 | 109 | 128 | 93 | 125 | 104 | 110 | 1,412 | 1,605 |
| Illinois | 1,128 | 1,108 | 1,330 | 1,388 | 1,440 | 1,462 | 1,642 | 2,062 | 2,553 | 2,768 | 3,067 | 3,981 | 23,929 | 7,499 |
| Indiana | 66 | 70 | 73 | 73 | 78 | 84 | 87 | 92 | 89 | 86 | 83 | 88 | 969 | 844 |
| Kansas | 5,680 | 4,786 | 5,292 | 5,104 | 4,758 | 4,702 | 4,869 | 5,190 | 4,821 | 4,835 | 4,724 | 4,826 | 59,587 | 70,761 |
| Kentucky | 411 | 406 | 457 | 432 | 459 | 487 | 506 | 553 | 547 | 526 | 514 | 523 | 5,821 | 5,484 |
| Louisiana | 7,843 | 7,224 | 8,014 | 7,718 | 7,954 | 7,816 | 8,195 | 8,065 | 7,954 | 8,429 | 7,689 | 7,911 | 94,812 | 90,924 |
| Michigan | 1,564 | 1,429 | 1,610 | 1,655 | 1,711 | 1,639 | 1,632 | 1,465 | 1,624 | 1,665 | 1,622 | 1,595 | 19,211 | 16,628 |
| Montana | 375 | 369 | 408 | 410 | 439 | 441 | 407 | 416 | 418 | 412 | 411 | 401 | 4,907 | 5,805 |
| New Mexico | 3,256 | 2,905 | 3,159 | 2,925 | 2,889 | 2,606 | 2,927 | 2,974 | 2,883 | 3,093 | 3,103 | 3,039 | 35,759 | 38,854 |
| New York | 444 | 409 | 455 | 429 | 447 | 418 | 404 | 429 | 406 | 404 | 391 | 409 | 5,045 | 5,478 |
| Ohio | 248 | 258 | 301 | 274 | 281 | 286 | 266 | 301 | 277 | 278 | 257 | 271 | 3,298 | 3,559 |
| Oklahoma | 17,409 | 14,986 | 16,297 | 15,137 | 14,388 | 12,919 | 13,941 | 14,616 | 14,079 | 14,066 | 13,228 | 13,816 | 174,882 | 228,839 |
| Pennsylvania | 1,566 | 1,466 | 1,653 | 1,497 | 1,517 | 1,432 | 1,385 | 1,460 | 1,377 | 1,383 | 1,318 | 1,372 | 17,426 | 19,189 |
| Texas | 40,847 | 35,639 | 41,514 | 40,515 | 37,710 | 36,360 | 42,315 | 43,781 | 37,828 | 39,738 | 38,857 | 40,510 | 475,614 | 510,318 |
| West Virginia | 290 | 294 | 337 | 317 | 322 | 326 | 304 | 325 | 315 | 320 | 257 | 277 | 3,684 | 3,845 |
| Wyoming | 1,465 | 1,261 | 1,499 | 1,468 | 1,510 | 1,717 | 1,730 | 1,814 | 1,748 | 1,649 | 1,582 | 1,561 | 19,004 | 19,166 |
| Other States [2] | 7 | 5 | 6 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 68 | 77 |
| Total United States: 1938 | 106,007 | 94,662 | 106,524 | 102,702 | 98,674 | 94,277 | 102,898 | 106,165 | 98,661 | 101,830 | 98,567 | 102,287 | 1,213,254 | |
| 1937 | 98,537 | 93,061 | 106,833 | 105,127 | 110,959 | 106,068 | 110,783 | 115,413 | 110,052 | 111,196 | 104,302 | 106,829 | | 1,279,160 |
| Daily average 1938 | 3,420 | 3,381 | 3,436 | 3,423 | 3,183 | 3,143 | 3,319 | 3,425 | 3,289 | 3,285 | 3,286 | 3,300 | 3,324 | 3,505 |

[1] Subject to revision.

[2] Missouri, Tennessee, and Utah.

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*Petroleum produced in the United States, 1934–38, and 1859–1938 total, by States* [1]

[Thousands of barrels of 42 gallons]

| | 1934 | 1935 | 1936 | 1937 | 1938 [2] | Total 1859–1938 [2] |
|---|---|---|---|---|---|---|
| Arkansas | 11,182 | 11,008 | 10,469 | 11,764 | 18,077 | 459,301 |
| California | 174,305 | 207,832 | 214,773 | 238,521 | 249,749 | 5,121,843 |
| Colorado | 1,139 | 1,560 | 1,650 | 1,605 | 1,412 | 36,866 |
| Illinois | 4,479 | 4,322 | 4,475 | 7,499 | 23,929 | 456,967 |
| Indiana | 838 | 777 | 822 | 844 | 969 | 124,395 |
| Kansas | 46,482 | 54,843 | 58,317 | 70,761 | 59,587 | [3] 993,614 |
| Kentucky | 4,860 | 5,258 | 5,633 | 5,484 | 5,821 | [4] 156,352 |
| Louisiana | 32,869 | 50,330 | 80,491 | 90,924 | 94,812 | 862,363 |
| Michigan | 10,603 | 15,776 | 11,928 | 16,628 | 19,211 | [5] 102,357 |
| Montana | 3,603 | 4,603 | 5,868 | 5,805 | 4,907 | 70,765 |
| New Mexico | 16,864 | 20,483 | 27,223 | 38,854 | 35,759 | [6] 197,993 |
| New York | 3,804 | 4,236 | 4,663 | 5,478 | 5,045 | [7] 108,680 |
| Ohio | 4,234 | 4,082 | 3,847 | 3,559 | 3,298 | 582,062 |
| Oklahoma | 180,107 | 185,288 | 206,555 | 228,839 | 174,882 | [3] 4,489,934 |
| Pennsylvania | 14,478 | 15,810 | 17,070 | 19,189 | 17,426 | [7] 962,333 |
| Texas | 381,516 | 392,666 | 427,411 | 510,318 | 475,614 | 5,602,834 |
| West Virginia | 4,095 | 3,902 | 3,847 | 3,845 | 3,684 | 403,746 |
| Wyoming | 12,556 | 13,755 | 14,582 | 19,166 | 19,004 | 453,795 |
| Other States [8] | 51 | 65 | 63 | 77 | 68 | 941 |
| Total United States | 908,065 | 996,596 | 1,099,687 | 1,279,160 | 1,213,254 | 21,187,141 |
| Value at wells: | | | | | | |
| Total (thousands of dollars) | 904,825 | 961,440 | 1,199,820 | 1,513,340 | 1,390,000 | 25,480,409 |
| Average per barrel | $1.00 | $0.96 | $1.09 | $1.18 | $1.15 | $1.20 |

[1] For detailed figures by States, 1859–1935, see Minerals Yearbook, 1937, p. 1008.
[2] Subject to revision.
[3] Oklahoma included with Kansas in 1905 and 1906.
[4] Includes Tennessee, 1883–1907.
[5] Figures represent 1925–38 production only; earlier years included under "Other States."
[6] Figures represent 1924–38 production only; earlier years included under "Other States."
[7] Early production in New York included with Pennsylvania.
[8] Includes Alaska, 1912–33; Arkansas, 1920; Michigan, 1900–1919; Mississippi, 1933–35; Missouri, 1889–1911, 1913–16, 1919–23, 1932–38; New Mexico, 1913, 1919–23; Tennessee, 1916–38; Utah, 1907–11, 1920, 1924–38.

*Percentage of total crude petroleum produced in the United States, 1930–38, by principal States*

| State | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|---|---|---|---|
| Texas | 32.4 | 39.1 | 39.8 | 44.5 | 42.0 | 39.4 | 38.9 | 39.9 | 39.2 |
| California | 25.3 | 22.2 | 22.7 | 19.0 | 19.2 | 20.9 | 19.5 | 18.6 | 20.6 |
| Oklahoma | 24.1 | 21.2 | 19.5 | 20.1 | 19.9 | 18.6 | 18.8 | 17.9 | 14.4 |
| Total, 3 States | 81.8 | 82.5 | 82.0 | 83.6 | 81.1 | 78.9 | 77.2 | 76.4 | 74.2 |
| Louisiana | 2.6 | 2.6 | 2.8 | 2.8 | 3.6 | 5.0 | 7.3 | 7.1 | 7.8 |
| Kansas | 4.7 | 4.4 | 4.4 | 4.6 | 5.1 | 5.5 | 5.3 | 5.5 | 4.9 |
| New Mexico | 1.1 | 1.8 | 1.6 | 1.6 | 1.9 | 2.1 | 2.5 | 3.1 | 3.0 |
| Illinois | .6 | .6 | .6 | .5 | .5 | .4 | .4 | .6 | 2.0 |
| Michigan | .4 | .4 | .9 | .9 | 1.2 | 1.5 | 1.1 | 1.3 | 1.6 |
| Arkansas | 2.2 | 1.7 | 1.5 | 1.3 | 1.1 | 1.1 | .9 | .9 | 1.5 |
| Pennsylvania | 1.4 | 1.4 | 1.6 | 1.4 | 1.6 | 1.6 | 1.6 | 1.5 | 1.4 |
| All other | 5.2 | 4.6 | 4.6 | 3.3 | 3.9 | 3.9 | 3.7 | 3.6 | 3.6 |
| Total United States | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

[1] Subject to revision.

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*Production of crude petroleum in leading fields in the United States, 1937–38, with total production since discovery* [1]

[Thousands of barrels]

| Field | State | 1937 | 1938 | Total since discovery |
|---|---|---|---|---|
| East Texas [2] | Texas | 170,700 | [3] 152,100 | 1,285,000 |
| Midway-Sunset | California | 26,500 | 22,900 | 858,000 |
| Seminole | Oklahoma | 30,500 | 26,300 | 786,000 |
| Long Beach | California | 21,900 | 20,600 | 621,000 |
| Oklahoma City | Oklahoma | 54,800 | [3] 40,800 | 450,000 |
| Santa Fe Springs | California | 15,800 | 12,600 | 447,000 |
| Bradford-Allegany | Pennsylvania-New York | 20,400 | 18,500 | 403,000 |
| Smackover | Arkansas | 6,900 | 6,500 | 373,000 |
| Coalinga | California | 5,800 | 3,900 | 355,000 |
| Cushing-Shamrock | Oklahoma | 3,900 | 3,800 | 336,000 |
| Augusta-Eldorado | Kansas | 6,000 | 5,700 | 289,000 |
| Salt Creek [2] | Wyoming | 5,900 | [3] 5,700 | 283,000 |
| Huntington Beach | California | 13,300 | 11,900 | 271,000 |
| Yates [2] | Texas | 11,400 | 7,400 | 247,000 |
| Kettleman Hills | California | 29,100 | 25,600 | 202,000 |
| Crane-Upton | Texas | 10,800 | 13,800 | 155,000 |
| Caddo [2] | Louisiana | 2,400 | [3] 2,700 | 149,000 |
| Pampa | Texas | 13,400 | 10,900 | 147,000 |
| Van [2] | do | 11,300 | [3] 5,600 | 115,000 |
| Conroe | do | 15,200 | 11,600 | 98,000 |
| Hobbs | New Mexico | 7,300 | 5,000 | 93,000 |
| Rodessa | Arkansas-Louisiana-Texas | 31,800 | 27,500 | 83,000 |
| Fitts | Oklahoma | 31,000 | 16,700 | 75,000 |
| Wilmington | California | 14,200 | 34,200 | 48,000 |

[1] Oil and Gas Journal, except as noted.
[2] Bureau of Mines.
[3] Subject to revision.

The upward trend in the production of Pennsylvania Grade oil was interrupted in 1938, when the output in all four of the States yielding this type of oil declined. The total production in 1938 was 27,316,000 barrels compared with 29,862,000 in 1937. The decline, most of which was in the Bradford field, was caused by the price reductions of 1938, aggregating 27 percent, or 70 cents per barrel.

*Pennsylvania grade crude oil produced, 1929–38, by States*

[Thousands of barrels]

| State | 1929 [1] | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 [2] |
|---|---|---|---|---|---|---|---|---|---|---|
| New York | 3,377 | 3,647 | 3,363 | 3,508 | 3,181 | 3,804 | 4,236 | 4,663 | 5,478 | 5,045 |
| Pennsylvania | 11,820 | 12,786 | 11,876 | 12,396 | 12,607 | 14,462 | 15,794 | 17,053 | 19,173 | 17,408 |
| West Virginia | 5,574 | 5,068 | 4,470 | 3,875 | 3,815 | 4,095 | 3,901 | 3,846 | 3,844 | 3,684 |
| Central and eastern Ohio | 2,654 | 2,742 | 2,184 | 1,741 | 1,594 | 1,597 | 1,547 | 1,510 | 1,367 | 1,179 |
| | 23,425 | 24,243 | 21,893 | 21,520 | 21,197 | 23,958 | 25,478 | 27,072 | 29,862 | 27,316 |

[1] Pennsylvania Grade Crude Oil Association. [2] Subject to revision.

*Arkansas.*—Considering the steady decline in production in Arkansas from 1925 to 1937, the gain from 11,764,000 barrels produced in 1937 to just over 18,000,000 barrels in 1938 was sensational. This advance was due primarily to the active development of the Schuler field, although Rodessa also helped out. About 200 oil wells were completed in 1938, or approximately double the 1937 total.

The new discoveries of 1938 were limited almost entirely to Smackover lime pools in Columbia County. Of these the Magnolia field appeared most important.

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*Production of crude petroleum in Arkansas, 1933–37, by districts* [1]

[Thousands of barrels]

| Year | Buckner | Champagnolle | El Dorado | Irma | Lisbon | Miller | Rodessa | Schuler | Smackover | Stephens | Urbana | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1933 | ------- | 488 | 1,231 | 264 | 95 | 100 | ------- | -------- | 8,882 | 127 | 499 | 11,686 |
| 1934 | ------- | 486 | 991 | 300 | 89 | 364 | ------- | -------- | 7,916 | 210 | 826 | 11,182 |
| 1935 | ------- | 872 | 862 | 391 | 66 | 444 | ------- | -------- | 7,368 | 212 | 793 | 11,008 |
| 1936 | ------- | 900 | 811 | 383 | 114 | 270 | ------- | -------- | 7,126 | 214 | 651 | 10,469 |
| 1937 | 21 | 522 | 747 | 433 | 80 | 154 | 1,252 | 1,153 | 6,751 | 205 | 446 | 11,764 |

[1] Figures by districts for 1938 not yet available.

*California.*—Production increased in California in 1938 for the fifth successive year, although the gain was not as large as that of 1937 over 1936. Although exports held up well, the total being slightly higher than in 1937, the domestic demand for all oils was materially lower. The increase in production, therefore, largely represented the degree to which curtailment efforts were outweighed by the superior forces of potential capacity. The voluntary proration program was heroically projected at various times, but the goal of 600,000 barrels of daily production was not in sight until very late in the year.

Measured in terms of number of wells, drilling declined materially in 1938 from 1937. However, from the standpoint of total footage there was little if any decrease, and in initial production there was a large gain. Thus the average initial per well per day for the oil wells completed in 1938 was about 930 barrels compared with about 540 barrels in 1937.

*Production of crude petroleum in California, 1934–38, by districts*

[Thousands of barrels]

| District | 1934 [1] | 1935 [1] | 1936 [1] | 1937 [1] | 1938 [1] |
|---|---|---|---|---|---|
| San Joaquin Valley: | | | | | |
| Belridge | 2,916 | 3,629 | 4,648 | 6,332 | 5,312 |
| Canal | | | | 31 | 849 |
| Coalinga | 6,525 | 7,249 | 6,067 | 5,759 | 3,898 |
| Edison | (3) | 979 | 2,023 | 1,577 | 1,102 |
| Elk Hills | 3,338 | 3,216 | 3,194 | 3,787 | 3,887 |
| Fruitvale | 1,313 | 1,848 | 2,903 | 3,246 | 3,078 |
| Greeley | | | | 527 | 1,164 |
| Kern River | 3,624 | 4,518 | 5,163 | 5,639 | 4,590 |
| Kettleman Hills | 21,391 | 27,607 | 29,287 | 29,132 | 25,609 |
| Lost Hills | 1,442 | 1,762 | 1,347 | 1,414 | 1,297 |
| McKittrick | 1,076 | 1,394 | 777 | 1,308 | 1,289 |
| Midway-Sunset | 19,651 | 20,240 | 21,482 | 26,485 | 22,875 |
| Mountain View | 2,581 | 9,229 | 9,713 | 6,843 | 4,033 |
| Mount Poso | 3,348 | 5,540 | 6,747 | 6,677 | 6,235 |
| Rio Bravo | | | | 128 | 1,945 |
| Round Mountain | 1,151 | 2,327 | 3,955 | 4,835 | 5,474 |
| Ten Section | | | | 932 | 2,473 |
| Other San Joquin Valley | 1,005 | 153 | 321 | 120 | 285 |
| Total San Joaquin Valley | 69,361 | 89,691 | 97,627 | 104,772 | 95,395 |

See footnotes at end of table.

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*Production of crude petroleum in California, 1934–38, by districts*—Continued

| District | 1934 [1] | 1935 [2] | 1936 [2] | 1937 [2] | 1938 [2] |
|---|---|---|---|---|---|
| Coastal district: | | | | | |
| Capitan | 194 | 522 | 571 | 918 | 1,067 |
| Elwood | 4,100 | 4,560 | 4,479 | 3,203 | 2,247 |
| Rincon | 538 | 670 | 754 | 1,058 | 1,395 |
| San Miguelito | 268 | 296 | 580 | 1,147 | 1,044 |
| Santa Maria | 1,749 | 1,531 | 1,668 | 3,893 | 6,128 |
| Ventura Avenue | 9,865 | 10,979 | 12,610 | 12,685 | 12,926 |
| Other Coastal | 2,008 | 2,653 | 2,239 | 2,113 | 2,089 |
| Total Coastal | 18,722 | 21,211 | 22,901 | 25,017 | 26,896 |
| Los Angeles Basin: | | | | | |
| Brea Olinda | 3,720 | 3,612 | 2,961 | 2,659 | 2,125 |
| Coyote | 4,112 | 4,540 | 3,944 | 4,269 | 4,354 |
| Dominguez | 6,650 | 7,916 | 9,712 | 9,839 | 9,756 |
| El Segundo | | | 149 | 3,632 | 3,872 |
| Huntington Beach | 15,006 | 15,133 | 13,247 | 13,255 | 11,917 |
| Inglewood | 3,364 | 4,477 | 4,547 | 5,530 | 5,337 |
| Long Beach | 22,788 | 26,563 | 24,994 | 21,872 | 20,599 |
| Montebello | 1,963 | 2,287 | 3,205 | 3,167 | 4,147 |
| Playa del Rey | 3,116 | 5,696 | 4,644 | 3,181 | 2,305 |
| Richfield | 2,856 | 2,804 | 2,443 | 3,158 | 3,333 |
| Rosecrans | 1,032 | 993 | 804 | 1,259 | 3,732 |
| Santa Fe Springs | 14,662 | 16,159 | 16,460 | 15,745 | 12,630 |
| Seal Beach | 2,715 | 3,381 | 3,463 | 3,416 | 3,198 |
| Torrance | 2,498 | 2,498 | 2,860 | 2,833 | 5,203 |
| Wilmington | | | | 14,186 | 34,168 |
| Other Los Angeles Basin | 1,740 | 871 | 812 | 731 | 782 |
| Total Los Angeles Basin | 86,222 | 96,930 | 94,245 | 108,732 | 127,458 |
| Total California | 174,305 | 207,832 | 214,773 | 238,521 | 249,749 |

[1] Central Committee of California Oil Producers.
[2] American Petroleum Institute.
[3] Included under "Other San Joaquin Valley."

Most of the fields declined in output in 1938, and only Wilmington, Santa Maria, Torrance, and Rosecrans increased appreciably. The Wilmington field became the leading field of the State by virtue of a gain from 14,186,000 barrels produced in 1937 to 34,168,000 barrels in 1938.

Exploration was extensive and generally successful in California in 1938, and a sizable net addition was made to reserves. Most of the new discoveries were in Kern County; the average depth of the new fields was about 8,000 feet. In point of reserves probably the Southeast Coalinga field was the most important discovery in California in 1937, but in general interest the Wasco discovery, Kern County, ranked first, because the discovery well set a new depth record of 15,004 feet, although the production was obtained from a zone at about 13,000 feet. Drilling in the Canal, Greeley, Montebello, Rio Bravo, Torrance, and Wilmington fields uncovered substantial new reserves, chiefly in new deep sands.

*Colorado.*—The downward turn in production in Colorado, which began in 1937, was accentuated in 1938 when only about 1,400,000 barrels were produced compared with 1,605,000 barrels in 1937. Seven oil wells were brought in in 1938 compared with only two in 1937, yet the total initial increased but slightly.

The Nelson Creek discovery of late 1937 was followed up with some success in 1938. The oil-producing areas within the Hiawatha gas field of Moffat County were enlarged during the year.

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*Production of crude petroleum in Colorado, 1933–37, by districts* [1]

[Thousands of barrels]

| Year | Florence [2] | Fort Collins [3] | Grease-wood | Iles | Moffat | Price | Rangely | Tow Creek | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1933 | 91 | 226 | 56 | 213 | 212 | ---------- | [4] 33 | 88 | 919 |
| 1934 | 83 | 186 | 37 | 529 | 173 | ---------- | [4] 60 | 71 | 1,139 |
| 1935 | 72 | 145 | 22 | 1,067 | 150 | ---------- | [4] 36 | 68 | 1,560 |
| 1936 | 73 | 119 | 19 | 1,176 | 161 | ---------- | [5] 37 | 65 | 1,650 |
| 1937 | 57 | 90 | 6 | 1,040 | 149 | 173 | [6] 33 | 57 | 1,605 |

[1] Figures by districts for 1938 not yet available.
[2] Includes Canon City.
[3] Includes Wellington.
[4] Includes Berthoud, Boulder, and Walden.
[5] Includes Berthoud and Boulder.
[6] Includes Berthoud.

*Illinois.*—Production in Illinois was trebled in 1938 over 1937, the output rising from 7,499,000 barrels to about 24,000,000 barrels. The 1938 production did not constitute a new record, several years around 1910 having larger totals. However, it is virtually a certainty that 1939 will bring a new peak. Production in 1938 rose steadily throughout the year, starting at about 35,000 barrels daily and reaching about 135,000 barrels by December 31. Drilling increased rapidly up to October, after which it tapered off with the advent of cold weather. At present the State ranks second only to Texas in completions.

Although the fields of Clay and Richland Counties in east central Illinois, the center of development in 1937, probably led in production in 1938, these fields declined rapidly as the center of interest shifted westward to the new discoveries in the Centralia district. These were the Centralia townsite pool, which had a rapid rise and decline in the middle of the year; Salem or Lake Centralia, the production of which rose to 50,000 daily by the end of the year; and Louden, in Fayette County, which was more conservatively developed than the others. In all fields 1,806 oil wells were completed compared with 272 in 1937 and 27 in 1936.

Another discovery of note was the finding of oil in the Devonian of the old Sandoval field. The fields of Clay and Richland Counties produce from the McClosky lime; but in the Centralia district the Benoist sand, several hundred feet above, was of primary importance until more and more operators began to explore the McClosky late in the year.

*Indiana.*—Although the number of oil wells completed in Indiana in 1938 declined slightly, the total initial trebled and the production rose from 844,000 barrels in 1937 to 969,000 barrels in 1938. The interest in Illinois developments spread to Indiana, and the resulting discoveries appeared more important than in many years.

*Kansas.*—The loss of markets and decline in price of crude dampened the enthusiasm of drillers in Kansas in 1938, and the number of oil wells completed—1,108—was about 40 percent lower than in 1937 and even below the level of 1936. However, wildcatters were unusually successful, and nearly 60 new pools were opened. These were scattered over more than a score of counties, Russell, Barton, and Stafford being prominent. Production crept farther west, Finney, Ford, and Graham Counties being added to the producing column in

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1938. Other interesting field developments were the increase in water-flood projects in the old southeastern fields and the prospecting in that part of the Forest City Basin that extends into northeast Kansas.

The production for the year was 59,587,000 barrels—16 percent less than the record of 70,761,000 barrels established in 1937. Production decreased in the majority of the fields. Notable exceptions were, however, Weathered, Cowley County; Gorham, Russell County; and Geneseo, Rose County.

*Production of crude petroleum in Kansas, 1934–38, by counties* [1]

[Thousands of barrels]

| County | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Barton | 446 | 738 | 1,195 | 3,519 | 3,490 |
| Butler: | | | | | |
| Eldorado district | 1,974 | 3,920 | 3,508 | 3,340 | 3,023 |
| Other districts | 5,392 | 2,792 | 2,656 | 2,649 | 2,668 |
| Cowley | 1,681 | 1,154 | 1,804 | 1,973 | 2,318 |
| Ellis | 167 | 167 | 758 | 2,629 | 3,116 |
| Ellsworth | 1,161 | 2,596 | 3,014 | 2,121 | 1,248 |
| Greenwood-Woodson | 4,378 | 4,089 | 4,001 | 4,007 | 3,834 |
| Harvey | 3,426 | 2,916 | 1,592 | 1,559 | 1,081 |
| McPherson: | | | | | |
| Graber district | 41 | 191 | 442 | 1,233 | 1,082 |
| Ritz Canton district | 4,644 | 2,974 | 2,346 | 1,872 | 1,650 |
| Voshell district | 2,413 | 1,670 | 1,104 | 931 | 765 |
| Other districts | 2,799 | 750 | 572 | 415 | 343 |
| Reno | 2,333 | 7,584 | 5,985 | 6,812 | 4,287 |
| Rice | 4,241 | 8,069 | 11,427 | 15,487 | 10,629 |
| Russell | 2,548 | 4,146 | 7,074 | 11,379 | 9,446 |
| Sedgwick | 2,765 | 2,973 | 2,002 | 1,545 | 1,418 |
| Sumner | 1,138 | 2,077 | 3,231 | 2,342 | 1,698 |
| Other counties | 4,207 | 4,558 | 4,373 | 5,345 | 6,038 |
| | 45,754 | 53,364 | 57,084 | 69,158 | 58,134 |

[1] Oil and Gas Journal.

*Kentucky.*—Despite considerable buyer proration in 1938, production increased to 5,821,000 barrels from 5,484,000 in 1937. Drilling declined in the western fields in 1938; nevertheless, the initial discovered was four times as large as in 1937. Two new McClosky lime pools, both in Henderson County, were discovered in 1938. Drilling in the eastern part of the State increased in 1938, but a high percentage of the completions were gas wells, and the 150 oil wells brought in averaged only 15 barrels initial.

*Louisiana.*—Production in Louisiana rose to a new peak in 1938, when 94,812,000 barrels were produced compared with 90,924,000 barrels in 1937. The northern fields about held their own, a 5,000,000-barrel decline at Rodessa being balanced by a comparable gain elsewhere, hence the increase was in the coastal district. Drilling increased slightly, as a loss in the northern fields was outweighed by a gain in the coastal or salt-dome fields.

Only one new field—Cross Lake near Shreveport—was discovered in the northern district in 1938. Deep sand discoveries continued important at Cotton Valley, this field and Lisbon supplying most of the gain to compensate Rodessa's decline.

In the coastal district exploration continued apace, and about 20 new fields were discovered in 1938. This record surpassed even that of the Texas Gulf Coast. Drilling was carried deeper and deeper, the deepest producing well in the world at the close of the

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year being one in the new Dulac field at about 13,260 feet. Extensions, flank production, and deeper sands too numerous to mention individually were found. The "Conroe trend" play was given a substantial boost by the discovery of flush Cockfield production at Bancroft, Beauregard Parish.

*Production of crude petroleum in Louisiana, 1933–37, by districts* [1]

[Thousands of barrels]

| District | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Gulf Coast: | | | | | |
| Black Bayou | 292 | 422 | 564 | 1,087 | 1,313 |
| Bosco | | 1,036 | 6,355 | 4,661 | 3,020 |
| Caillou Island | 362 | 1,748 | 3,288 | 5,504 | 6,402 |
| Cameron Meadows | (2) | 419 | 1,046 | 1,848 | 1,490 |
| Choctaw | 100 | 324 | 276 | 346 | 440 |
| Darrow | | (2) | 263 | 526 | 717 |
| Dog Lake | | | (2) | 227 | 674 |
| English Bayou | | | 713 | 2,511 | 2,871 |
| Gibson | | | | | 453 |
| Gillis | | (2) | 1,492 | 3,262 | 2,217 |
| Gueydan | 165 | 110 | 82 | 58 | 99 |
| Hackberry | 1,938 | 1,911 | 2,580 | 3,125 | 4,592 |
| Iowa | 3,396 | 5,300 | 7,363 | 6,626 | 6,383 |
| Jeanerette | | | (2) | 985 | 2,277 |
| Jennings | 400 | 444 | 686 | 754 | 2,996 |
| Lafitte | | | 635 | 2,709 | 4,136 |
| Lake Barre | 3,021 | 1,894 | 2,792 | 2,532 | 1,368 |
| Leeville | 359 | 4,487 | [3] 5,388 | 4,679 | 2,629 |
| Lockport | 938 | 714 | 655 | 474 | 528 |
| New Iberia | | | (2) | 2,191 | 6,231 |
| Port Barre | 956 | 937 | 1,250 | 797 | 600 |
| Roanoke | | 241 | 1,631 | 2,282 | 1,890 |
| Sulphur | 910 | 1,256 | 944 | 1,793 | 1,414 |
| Sweet Lake | 335 | 385 | 403 | 350 | 294 |
| Tepetate | | | (2) | 1,456 | 2,158 |
| Valentine | | | | | 968 |
| Vinton | 1,302 | 1,168 | 906 | 650 | 470 |
| White Castle | 192 | 191 | 196 | 336 | 490 |
| Other Gulf Coast | 640 | 807 | 1,268 | 1,805 | 2,921 |
| Total Gulf Coast | 15,306 | 23,794 | 40,776 | 53,574 | 62,041 |
| Northern: | | | | | |
| Caddo | 2,248 | 2,200 | 2,630 | 2,554 | 2,353 |
| Cotton Valley | 307 | 290 | 233 | 207 | 1,151 |
| Haynesville | 1,402 | 1,379 | 1,266 | 1,216 | 1,143 |
| Homer | 991 | 980 | 977 | 950 | 932 |
| Lisbon | | | | | 2,490 |
| Rodessa | | | 1,364 | 19,220 | 18,050 |
| Urania | 883 | 1,077 | 1,062 | 1,060 | 1,085 |
| Zwolle | 3,007 | 1,675 | 626 | 393 | 266 |
| Other Northern | 1,024 | 1,474 | 1,396 | 1,317 | 1,413 |
| Total Northern | 9,862 | 9,075 | 9,554 | 26,917 | 28,883 |
| Total Louisiana | 25,168 | 32,869 | 50,330 | 80,491 | 90,924 |

[1] Figures by districts for 1938 not yet available.
[2] Included under "Other Gulf Coast."
[3] Leeville includes New Iberia.

*Michigan.*—Production in Michigan reached a new peak of 19,211,000 barrels in 1938 compared with the previous record of 16,628,000 barrels in 1937. The several declines in Michigan crude-oil prices, totaling 35 cents or more per barrel, dimmed the enthusiasm for development work; nevertheless, the number of oil wells brought in—566—was only 20 less than in 1937.

About a half dozen new fields were uncovered in Michigan in 1938, most of them being in the southwest corner of the State in nearly virgin territory. Of the new fields, Bloomingdale, Van Buren County, was the most active, but Freeman-Redding, Clare County, yielded the largest wells and appeared to have the most promising future.

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*Production of crude petroleum in Michigan, 1933–37, by districts* [1]

[Thousands of barrels]

| Year | Buckeye | Clayton | Crystal | Mount Pleasant | Muskegon | Porter | Sherman | Vernon | West Branch | Yost-Jasper | Other districts | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1933 | ------- | ------- | ------- | 3,129 | 276 | 3,354 | ------- | 539 | -------- | 219 | 425 | 7,942 |
| 1934 | ------- | ------- | ------- | 1,513 | 159 | 7,168 | ------- | 907 | -------- | 276 | 580 | 10,603 |
| 1935 | ------- | ------- | 3,605 | 1,130 | 102 | 8,317 | ------- | 633 | 524 | 875 | 590 | 15,776 |
| 1936 | 10 | 58 | 2,449 | 880 | 93 | 4,620 | 32 | 469 | 772 | 1,625 | 920 | 11,928 |
| 1937 | 6,428 | 1,030 | 573 | 801 | 77 | 2,707 | 1,532 | 388 | 862 | 1,158 | 1,072 | 16,628 |

[1] Figures by districts for 1938 not yet available. Data from Department of Conservation, Michigan.

*Mississippi.*—The potentialities of Mississippi as an oil producer are still favorably considered in some quarters, but developments of 1938 did little to enhance them. There was no commercial production reported in 1938, and drilling yielded but 6 gas wells and 19 dry holes.

*Montana.*—Production in Montana declined materially in 1938 (from 5,805,000 barrels in 1937 to 4,907,000 in 1938) as exports of crude to Canada decreased from 1,950,000 barrels in 1937 to 356,000 in 1938. Drilling again declined severely, and only about half as many oil wells were completed in 1938 as in 1937. The only new oil discovery was a field about 5 miles north of the Cut Bank field.

*Production of crude petroleum in Montana, 1933–37, by districts* [1]

[Thousands of barrels]

| Year | Border | Cat Creek | Cut Bank | Dry Creek | Elk Basin | Kevin-Sunburst | Lake Basin | Pondera | Other districts | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1933 | 51 | 266 | 238 | 125 | 3 | 1,237 | 18 | 308 | 27 | 2,273 |
| 1934 | 70 | 236 | 1,204 | (2) | 16 | 1,628 | 16 | 363 | 70 | 3,603 |
| 1935 | 40 | 311 | 2,321 | (2) | 11 | 1,371 | (2) | 441 | 108 | 4,603 |
| 1936 | 43 | 258 | 3,332 | 214 | 12 | 1,543 | (2) | 433 | 33 | 5,868 |
| 1937 | 41 | 227 | 3,332 | 102 | 12 | 1,634 | (2) | 418 | 39 | 5,805 |

[1] Figures by districts for 1938 not yet available. [2] Included under "Other districts."

*New Mexico.*—Owing primarily to relatively greater curtailment, the output of New Mexico declined from the 1937 peak of 38,854,000 barrels to 35,759,000 in 1938. The number of oil wells brought in dropped 14 percent from 1937, but the total initial of 1938 was hardly a third of what it was in the preceding year. The Monument field succeeded Eunice as the leading producer. The Vacuum field led in development work in 1938. Extensions to old fields were numerous, but new fields discovered were limited to one oil field, West Eunice, and one gas field that promised to develop into an oil field.

*Production of crude petroleum in New Mexico, 1933–37, by districts* [1]

[Thousands of barrels]

| Year | Artesia | Hobbs | Hogback | Lea [2] | Rattlesnake [3] | Total |
|---|---|---|---|---|---|---|
| 1933 | 596 | 11,543 | 77 | 1,609 | 291 | 14,116 |
| 1934 | 898 | 12,628 | 76 | 2,962 | 300 | 16,864 |
| 1935 | 867 | 11,276 | 69 | 7,970 | 301 | 20,483 |
| 1936 | 1,056 | 9,169 | 84 | 16,592 | 322 | 27,223 |
| 1937 | 2,000 | 7,300 | 71 | 29,166 | 317 | 38,854 |

[1] Figures by districts for 1938 not yet available.
[2] Includes Cooper, Eunice, Jal, Monument, and other pools in Lea County.
[3] Includes Aztec and Table Mesa in 1933–35; Aztec, Bloomfield, Red Mountain, and Table Mesa in 1936; Aztec, Bloomfield, Hospah, and Table Mesa in 1937.

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*New York.*—Field activity in New York in 1938 was depressed owing to the low prices; drilling declined severely and production decreased from 5,478,000 barrels in 1937 to 5,045,000 in 1938.

*Ohio.*—Drilling continued to decline in Ohio, and production still trended downward. The output in 1938 was 3,298,000 barrels, including 582,000 barrels from the Lima district, compared with 3,559,000 barrels in 1937.

*Oklahoma.*—Generally lower demand and a loss of markets to Illinois and possibly other States were the underlying factors in reducing production in Oklahoma from 228,839,000 barrels in 1937 to 174,882,000 in 1938.

The output of all the major fields fell in 1938, a decrease of about 20,500,000 barrels for the Oklahoma City field being largest and of about 14,000,000 barrels at Fitts being second. Many of the more prominent Wilcox sand areas declined 50 percent or more between 1937 and 1938. Much of the field work in 1938 was conducted in the greater Seminole district, hence production decline was comparatively small, from 49,772,000 barrels in 1937 to 42,182,000 in 1938.

*Production of crude petroleum in Oklahoma, 1934–38, by districts* [1]

[Thousands of barrels]

| District | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Allen | 3,065 | 2,897 | 3,076 | 2,511 | 2,475 |
| Billings | 37 | 77 | 204 | 2,349 | 2,108 |
| Bristow | 3,000 | 3,329 | 3,186 | 2,790 | 2,389 |
| Burbank | 3,406 | 3,102 | 2,827 | 2,871 | 2,814 |
| Cleveland County | | | 543 | 3,896 | 1,778 |
| Crescent | 1,237 | 2,003 | 2,301 | 3,851 | 1,687 |
| Cushing-Shamrock | 5,044 | 4,738 | 4,129 | 3,908 | 3,848 |
| Dora | | | | 205 | 1,732 |
| Edmond | 92 | 1,478 | 4,370 | 5,884 | 2,030 |
| Fish | 1,381 | 3,422 | 3,114 | 2,077 | 1,224 |
| Fitts | 329 | 6,901 | 19,908 | 30,977 | 16,655 |
| Healdton | 3,386 | 3,397 | 3,436 | 3,654 | 3,401 |
| Keokuk-South Keokuk | 388 | 852 | 2,113 | 2,979 | 1,713 |
| Lucien | 2,903 | 3,744 | 4,542 | 5,047 | 3,524 |
| Nowata County | 2,258 | 2,414 | 3,179 | 3,450 | 4,390 |
| Oklahoma City | 60,833 | 53,386 | 51,232 | 54,776 | 38,796 |
| Okmulgee County | 2,030 | 1,796 | 1,692 | 1,752 | 1,753 |
| Olympic | | | 2,711 | 4,315 | 1,889 |
| Osage (outside Burbank-South Burbank) | 9,187 | 9,113 | 8,293 | 7,626 | 6,438 |
| Seminole field: | | | | | |
| Bowlegs | 3,761 | 3,845 | 4,335 | 4,178 | 3,200 |
| Carr City | 2,039 | 2,003 | 2,216 | 1,973 | 1,294 |
| Earlsboro | 7,680 | 7,414 | 6,601 | 5,596 | 3,751 |
| Little River | 5,371 | 5,587 | 5,068 | 4,222 | 3,040 |
| St. Louis-Pearson | 8,084 | 8,365 | 8,543 | 7,528 | 7,766 |
| Seminole City | 3,779 | 4,062 | 3,810 | 3,428 | 2,842 |
| Other Seminole districts | 5,388 | 3,347 | 4,150 | 3,574 | 4,448 |
| Total Seminole field | 36,102 | 34,623 | 34,723 | 30,499 | 26,341 |
| Sholem-Alechem-Tatums | 3,993 | 3,100 | 2,561 | 3,129 | 1,691 |
| South Burbank | 2,279 | 4,217 | 5,390 | 5,579 | 3,938 |
| Tulsa | 1,465 | 1,432 | 1,308 | 1,721 | 1,513 |
| Other districts | 36,237 | 36,516 | 36,043 | 37,261 | 35,180 |
| Total Oklahoma | 178,652 | 182,597 | 200,881 | 223,107 | 169,307 |

[1] Oil and Gas Journal.

Hardly half as many oil wells were completed in 1938 as in 1937—986 against 1,852. Furthermore, the wells of 1938 were of much smaller average size; in fact, the total initial for 1938 (215,000 barrels) was the lowest in 29 years. Incentives for an active drilling campaign generally were lacking, hence many of the operators who had not

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migrated to other States "marked time" in 1938 by working over old wells (not recorded as new completions) or testing shallow horizons, particularly in the greater Seminole district where they had been passed up in the haste to reach the prolific Wilcox zone.

Wildcatting in 1938 had considerable success, although no new large fields were uncovered. Considered the most important new field was Ramsey, Payne County, which, though small in area, yielded unusually large wells. Hillsdale, Garfield County, was considered an important find, as it extended the producing area of the State to the northwest and opened a large area to exploration. The Coyle and Meridian fields, Payne and Logan Counties, respectively, were 1938 Wilcox discoveries of considerable promise. Important among deep-sand developments was the drilling of about 40 wells in the old Cement field, Caddo County.

*Pennsylvania.*—The 30-percent decline in the average price of Pennsylvania Grade crude oil in 1938 greatly depressed field work in Pennsylvania. Oil wells completed in 1938 totaled about 45 percent below 1937. Production, which had increased steadily since 1931, dropped from 19,189,000 barrels in 1937 to 17,426,000 in 1938.

*Texas.*—Lower demand and introduction of the Saturday and Sunday shut-downs in Texas in 1938 caused the trend of production to turn downward, and 475,614,000 barrels were produced compared with the peak of 510,318,000 barrels in 1937.

No change was made in the Bureau's districts for Texas, which remain as follows: For the monthly publications—Panhandle, West Texas, East Texas proper, Rodessa, Gulf Coast, and "Rest of State"; for the annual chapter—Panhandle, North, West, Central, East, and South Texas, and the Gulf Coast. East Texas in the annual report includes East Texas proper and Rodessa, as well as Van and other fields in that part of the State.

Drilling declined materially in the Panhandle in 1938, and production decreased from 27,617,000 barrels in 1937 to 23,556,000 in 1938. All five producing counties shared in the decline. Natural-gas discoveries outranked oil discoveries in the Panhandle in 1938, as only one oil field was found.

The development of the K-M-A field of Wichita County overshadowed all others in the North Texas district in 1938. About 700 or 800 oil wells were completed in the field in 1938 for a total initial of about 600,000 barrels. Although drilling elsewhere maintained the pace of 1937, production at K-M-A and other fields was held down by proration so that the total output for the district was about the same as in 1937.

Wildcatters, greatly encouraged by the results of deeper drilling in recent years, continued active, and a score or more new productive spots were found in North Texas in 1938. Jones County, on the west edge of the district, led in new discoveries. Outstanding new fields were Steffens, Jones County; Holliday, on the Wichita-Archer County line; and Hull-Silk, Archer County, which had three distinct producing zones.

Production in the West Texas district in 1938 was 72,653,000 barrels, or only slightly under the 75,743,000 barrels produced in 1937. Drilling in 1938 was about 25 percent lower than in 1937, but was partly offset by a gain in the average initial.

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*Production of crude petroleum in Texas, 1933–37, by districts* [1]

[Thousands of barrels]

| District | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Gulf Coast: | | | | | |
| Anahuac | | | 358 | 2,606 | 4,318 |
| Barbers Hill | 8,082 | 6,820 | 6,765 | 5,461 | 4,366 |
| Batson | 208 | 246 | 588 | 638 | 630 |
| Boling | 126 | 209 | 182 | 348 | 545 |
| Conroe | 21,215 | 17,761 | 15,276 | 15,229 | 15,191 |
| Dickinson | | [2] | 280 | 719 | 1,432 |
| Esperson | 481 | 452 | 395 | 630 | 601 |
| Flour Bluff | | | | 93 | 1,607 |
| Friendswood | | | | | 88 |
| Goose Creek | 1,163 | 1,203 | 1,069 | 1,038 | 860 |
| Greta | 1,195 | 3,936 | 4,769 | 5,481 | 6,635 |
| Hankamer | 547 | 378 | 565 | 779 | 576 |
| Hardin | | | | 135 | 241 |
| Hastings | | | 689 | 2,408 | 5,835 |
| Heyser | | | | 120 | 1,515 |
| High Island | 2,534 | 2,747 | 2,513 | 2,069 | 1,183 |
| Hull | 1,946 | 3,453 | 2,311 | 1,950 | 2,492 |
| Humble | 1,722 | 1,188 | 1,230 | 1,163 | 1,217 |
| Luby | | | | | 80 |
| Manvel | 586 | 1,020 | 2,467 | 3,014 | 3,458 |
| Markham | 351 | 389 | 459 | 540 | 612 |
| Mykawa | 70 | 133 | 705 | 1,161 | 632 |
| Old Ocean | | [2] | 104 | 159 | 447 |
| Orange | 312 | 289 | 263 | 250 | 248 |
| Pierce Junction | 1,524 | 1,196 | 1,093 | 1,298 | 1,243 |
| Placedo | | | 143 | 1,393 | 3,082 |
| Plymouth | | | 650 | 3,400 | 5,056 |
| Raccoon Bend | 1,544 | 1,489 | 1,681 | 1,922 | 2,002 |
| Refugio | 2,105 | 1,489 | 1,641 | 3,228 | 2,307 |
| Saxet-Saxet Heights | 861 | 775 | 1,336 | 7,245 | 15,763 |
| Segno | | | | | 472 |
| Silsbee | | | | 6 | 464 |
| Sourlake | 453 | 484 | 602 | 561 | 569 |
| Spindletop | 1,149 | 1,052 | 962 | 858 | 912 |
| Sugarland | 2,532 | 2,183 | 2,098 | 1,715 | 1,322 |
| Thompsons | 4,906 | 4,245 | 4,123 | 3,523 | 4,147 |
| Tomball | 233 | 990 | 1,899 | 2,611 | 3,060 |
| West Columbia | [3] 1,441 | 1,038 | 857 | 773 | 825 |
| Withers | | | | 229 | 570 |
| Other Gulf Coast | 3,716 | 4,990 | 6,841 | 12,235 | 18,099 |
| Total Gulf Coast | 61,002 | 60,155 | 64,914 | 86,988 | 114,702 |
| East Texas: | | | | | |
| East Texas proper [4] | 204,954 | 181,540 | 176,859 | 167,512 | 170,673 |
| Cayuga | | 589 | 1,333 | 2,137 | 3,195 |
| Long Lake | [5] | [5] | [5] | 374 | 549 |
| Rodessa | | | 12 | 3,144 | 12,626 |
| Sulphur Bluff | | | | | 1,627 |
| Talco | | | | 1,344 | 9,720 |
| Van | 17,077 | 14,621 | 14,062 | 12,508 | 11,346 |
| Other East Texas | 341 | 311 | 813 | 726 | 589 |
| Total East Texas | 222,372 | 197,061 | 193,079 | 187,745 | 210,325 |
| Central Texas: | | | | | |
| Darst Creek | 4,565 | 3,374 | 3,298 | 3,201 | 2,802 |
| Luling | 2,368 | 2,187 | 2,055 | 2,154 | 2,260 |
| Lytton Springs | 405 | 557 | 341 | 328 | 120 |
| Mexia [6] | 2,064 | 1,947 | 1,902 | 1,847 | 1,678 |
| Salt Flat (Bruner) | 2,020 | 1,637 | 1,495 | 1,448 | 1,586 |
| Other Central Texas | 2,108 | 2,334 | 4,356 | 4,896 | 5,125 |
| Total Central Texas | 13,530 | 12,036 | 13,447 | 13,874 | 13,571 |
| North Texas [7] | 26,293 | 31,558 | 31,098 | 33,041 | 37,580 |
| Panhandle [8] | 16,673 | 20,280 | 21,369 | 22,357 | 27,617 |
| South Texas [9] | 7,395 | 10,154 | 13,342 | 21,367 | 30,780 |

[1] Figures by districts for 1938 not yet available.
[2] Included under "Other Gulf Coast."
[3] Includes Damon Mound and Nash.
[4] Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[5] Included under "Other East Texas."
[6] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[7] Includes the districts in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[8] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[9] Includes fields in Duval, Hidalgo, Jim Hogg, Jim Wells, Starr, Webb, and Zapata Counties.

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*Production of crude petroleum in Texas, 1933–37, by districts*—Continued

| District | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| West Texas: | | | | | |
| Andrews | (10) | 217 | 628 | 857 | 1,318 |
| Big Lake | 6,535 | 4,476 | 3,610 | 2,859 | 2,648 |
| Chalk-Roberts [11] | 6,257 | 6,563 | 8,163 | 9,345 | 8,663 |
| Crane-Upton | 6,396 | 6,145 | 6,384 | 7,843 | 10,078 |
| Ector | 1,944 | 2,625 | 3,591 | 5,759 | 10,121 |
| Fisher | 944 | 1,633 | 1,954 | 1,640 | 1,164 |
| Hendricks | 8,263 | 7,612 | 7,670 | 9,801 | 15,411 |
| Ward County | 2,559 | 3,479 | 5,883 | 8,992 | 12,561 |
| Yates | 20,723 | 15,991 | 15,935 | 13,414 | 11,388 |
| Other West Texas | 1,723 | 1,531 | 1,599 | 1,529 | 2,391 |
| Total West Texas | 55,344 | 50,272 | 55,417 | 62,039 | 75,743 |
| Total Texas | 402,609 | 381,516 | 392,666 | 427,411 | 510,318 |

[10] Included under "Other West Texas."
[11] Includes Westbrook and other fields in Glasscock, Howard, and Mitchell Counties.

About a dozen new fields in nearly as many counties were found in 1938. Among these, Dunes, Crane County, and Payton, Pecos County, were most prominent. The Wasson field of Gaines County and the Denver field of Yoakum County were joined, and future drilling promises to link up other productive spots into a field of 50,000 or more acres, the largest in the district. Prospecting in the Ordovician, an expensive type of recreation for wildcatters in West Texas, was generally disappointing in 1938.

Reduced allowables due primarily to the week-end shut-downs were responsible for a decline of production in the East Texas field proper from 170,673,000 barrels in 1937 to 152,143,000 in 1938. The average bottom-hole pressure, a factor in determining the allowable, decreased but slightly in 1938 and actually increased in the last few months of the year. The net drop was from about 1,123 pounds per square inch on January 1 to 1,110 on December 31. Drilling declined sharply, only 1,599 oil wells being brought in during 1938 compared with 2,252 in 1937. However, the average daily initial gain increased from 1,214 barrels in 1937 to 1,282 in 1938.

Production in the other fields of the East Texas district fell from about 40,000,000 barrels in 1937 to about 33,000,000 in 1938. Van bore the brunt of the decrease; the Rodessa and Talco fields produced nearly as much as in the previous year. Several distillate discoveries of questionable significance and one oil field—Navarro Crossing, Houston County—comprised the principal realization from exploration work in 1938.

The Central Texas district, including chiefly the fault-line pools, passed another quiet year, with no important discoveries and with production continuing its gradual decline. Several new fields were found in Bexar and other counties, but they were small.

The rapid rise of production in the South Texas district, often referred to as the Laredo district, was halted in 1938, and production dropped from 30,780,000 barrels in 1937 to just under 30,000,000.

Drilling activity was definitely off, but the number of discoveries probably increased. The principal discoveries in 1938 were along the "Jackson trend," although wildcatting along the Cockfield and Pettus trends yielded favorable results. The trend type of geology probably finds wider use here than anywhere else in the country. Of the new discoveries, South Alice (Jim Wells County), Sun (Starr County), and Kelsey (Jim Hogg County) appeared outstanding. Many of the new

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fields were 4,000 to 5,000 feet deep, which would be shallow in some parts of the country but is considerably deeper than the average wildcat of this district 10 years ago.

The Texas Gulf Coast was the only district in the State that gained in output in 1938, its production rising from 114,702,000 barrels in 1937 to 115,303,000 in 1938. The small increase was related to changes in the allowables, because drilling and total initial declined as in the rest of the State.

Although Conroe suffered a severe recession in output in 1938 it continued to be far and away the most important producer in the district. The production of most of the old fields declined in 1938, gains at Hastings, Old Ocean, Friendswood, and other fields just offsetting the losses.

For the first time, the number and aggregate estimated importance of the new discoveries in the Texas Gulf Coast were surpassed in the Louisiana Gulf Coast. However, about a dozen new productive spots were uncovered in Coastal Texas, several of which were situated offshore. Of the new discoveries, Cedar Point, Eureka, and Fairbanks appeared outstanding.

*Utah.*—Field work in Utah in 1938 was devoted to natural gas, and the oil production was only 12,000 barrels.

*West Virginia.*—Conditions in West Virginia in 1938 favored continuance of the general decline in production evidenced for the last 25 years. The output in 1938 was 3,684,000 barrels compared with 3,845,000 in 1937. The number of oil wells completed declined materially, but the total initial increased.

*Wyoming.*—Production in Wyoming declined but slightly in 1938—from 19,166,000 barrels in 1937 to 19,004,000 in 1938. Wyoming was one of the few States in which drilling increased; 95 oil wells were completed in 1938 compared with 72 in 1937.

Production in the Salt Creek field continued its slow but steady decline. However, it still held a considerable margin over the second-ranking field, Lance Creek, whose production increased in 1938 following a markedly successful drilling program.

Several new oil and gas fields were discovered, but only one deserves mention here—the Cole Creek field, Natrona County, which produces from about 8,000 feet.

*Production of crude petroleum in Wyoming, 1933–37, by districts* [1]

[Thousands of barrels]

| Year | Big Muddy | Byron | Elk Basin | Frannie | Garland | Grass Creek | Hamilton Dome-Warm Springs | La Barge | Lance Creek | Lander-Dallas-Derby Dome | Lost Soldier-Ferris |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1933 | 650 | (2) | 203 | 85 | [3] 181 | 274 | 254 | 349 | 41 | 330 | 632 |
| 1934 | 634 | (2) | 177 | 615 | [3] 364 | 356 | 322 | 488 | 128 | 316 | 605 |
| 1935 | 570 | (2) | 133 | 114 | [3] 784 | 727 | 470 | 493 | 735 | 334 | 563 |
| 1936 | 522 | (2) | 159 | 310 | [3] 318 | 559 | 426 | 471 | 1,892 | 330 | 471 |
| 1937 | 484 | 404 | 104 | 358 | 844 | 654 | 437 | 423 | 4,247 | 329 | 511 |

| Year | Medicine Bow | Oregon Basin | Osage | Poison Spider-South Casper | Quealy | Rock Creek | Salt Creek | Other districts | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1933 | ---------- | 252 | 241 | 167 | ---------- | 464 | 7,009 | 95 | 11,227 |
| 1934 | ---------- | 880 | 289 | 177 | ---------- | 540 | 6,520 | 145 | 12,556 |
| 1935 | ---------- | 1,638 | 174 | 131 | ---------- | 544 | 6,257 | 88 | 13,755 |
| 1936 | 167 | 1,733 | 143 | 206 | ---------- | 622 | 6,070 | 183 | 14,582 |
| 1937 | 1,344 | 1,407 | 261 | 230 | 268 | 748 | 5,874 | 239 | 19,166 |

[1] Figures by districts for 1938 not yet available.

[2] Garland includes Byron.



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## WELLS

Owing to the unsettled price situation, drilling for oil and gas declined materially in 1938 from 1937. Total completions in 1938 were about 27,400, or nearly 4,000 fewer holes than in 1937. Of the total completions in 1938 70 percent were oil wells, 8 percent gas wells, and 22 percent dry holes. Compared with 1937 these data indicate chiefly an increase in the ratio of failures (see fig. 4). There were 363,030 producing oil wells at the beginning of 1938, and allowing for the customary percentage of abandonments this total may have reached 374,000 by the end of the year. The average production per well per day, which had increased steadily since 1934, dropped from 9.8 barrels in 1937 to about 9.0 barrels in 1938.

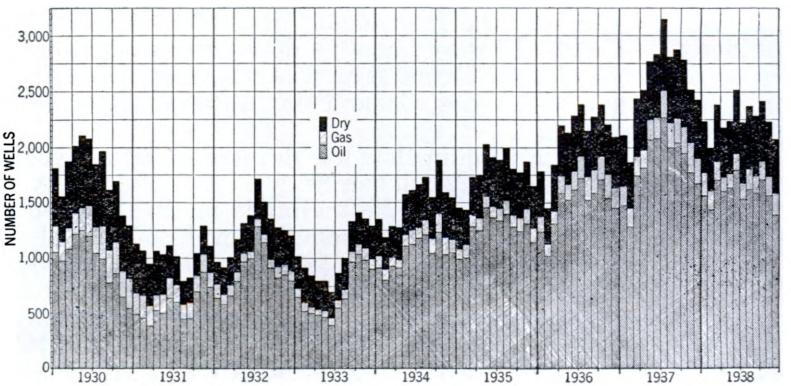


FIGURE 4.—Wells drilled, 1930–38, by months.

Although drilling declined materially in the East Texas field in 1938, it led in number of completions, with Wichita County in second place. The Bradford-Allegany district led in total number of holes drilled, but a large percentage were water-drive holes. The increases in field activity in several Illinois counties were the most spectacular developments in 1938.

*Wells drilled for oil and gas in the United States in 1938, by months* [1]

| Wells | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Number | Percent |
| Oil | 1,563 | 1,440 | 1,701 | 1,600 | 1,632 | 1,790 | 1,534 | 1,624 | 1,585 | 1,705 | 1,558 | 1,389 | 19,121 | 70.4 |
| Gas | 209 | 168 | 173 | 129 | 127 | 154 | 145 | 180 | 156 | 168 | 179 | 197 | [2] 1,985 | 7.3 |
| Dry | 464 | 391 | 506 | 452 | 479 | 572 | 547 | 566 | 542 | 543 | 494 | 487 | 6,043 | 22.3 |
| Total: 1938 | 2,236 | 1,999 | 2,380 | 2,181 | 2,238 | 2,516 | 2,226 | 2,370 | 2,283 | 2,416 | 2,231 | 2,073 | 27,149 | 100.0 |
| 1937 [3] | 2,107 | 1,860 | 2,442 | 2,515 | 2,769 | 2,835 | 3,153 | 2,813 | 2,876 | 2,786 | 2,520 | 2,430 | 31,106 | ------ |

[1] Oil and Gas Journal.
[2] Total by months does not agree with total by States published elsewhere in the Yearbook, as latter has been revised on basis of annual data from State officials.
[3] Water-intake wells not included.

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*Wells drilled in the United States and estimated average daily initial oil production per well, 1937–38, by States and districts* [1]

| State and district | 1937 | | | | | 1938 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Oil | | Gas | Dry | Total | Oil | | Gas | Dry | Total |
| | Number | Average initial (barrels) | | | | Number | Average initial (barrels) | | | |
| Arkansas | 103 | 665 | 6 | 78 | 187 | 204 | 683 | 3 | 44 | 251 |
| California [2] | 1,147 | 539 | 17 | 314 | 1,478 | 993 | 927 | 7 | 265 | 1,265 |
| Colorado | 2 | 450 | 2 | 23 | 27 | 7 | 135 | 1 | 10 | 18 |
| Illinois | 272 | 295 | 3 | 117 | 392 | 1,806 | 271 | 23 | 408 | 2,237 |
| Indiana | 47 | 12 | 39 | 58 | 144 | 46 | 37 | 43 | 69 | 158 |
| Kansas | 1,867 | 792 | 357 | 606 | 2,830 | 1,108 | 581 | 200 | 402 | 1,710 |
| Kentucky | 407 | 35 | 193 | 234 | 834 | 484 | 89 | 91 | 314 | 889 |
| Louisiana: | | | | | | | | | | |
| Gulf Coast | 273 | 510 | 10 | 170 | 453 | 329 | 388 | 10 | 186 | 525 |
| Northern | 406 | 440 | 138 | 136 | 680 | 361 | 465 | 116 | 145 | 622 |
| Total Louisiana | 679 | 468 | 148 | 306 | 1,133 | 690 | 429 | 126 | 331 | 1,147 |
| Michigan | 586 | 525 | 69 | 277 | 932 | 566 | 451 | 28 | 406 | 1,000 |
| Montana | 135 | 95 | 26 | 56 | 217 | 69 | 78 | 21 | 27 | 117 |
| New Mexico | 574 | 944 | 27 | 64 | 665 | 494 | 370 | 19 | 67 | 580 |
| Ohio | 316 | 22 | 497 | 432 | 1,245 | 189 | 23 | 433 | 288 | 910 |
| Oklahoma | 1,852 | 366 | 123 | 697 | 2,672 | 986 | 218 | 160 | 545 | 1,691 |
| Pennsylvania and New York | 2,861 | 3 | 186 | 93 | 3,140 | 2,378 | 4 | 166 | 95 | 2,639 |
| Texas: | | | | | | | | | | |
| Gulf Coast | 1,321 | 492 | 61 | 313 | 1,695 | 1,106 | 425 | 36 | 269 | 1,411 |
| East Texas proper | 2,252 | 1,214 | ------- | 77 | 2,329 | 1,599 | 1,282 | 1 | 45 | 1,645 |
| West Texas | 2,464 | 819 | 11 | 331 | 2,806 | 1,788 | 877 | 16 | 241 | 2,045 |
| Rest of State | 4,989 | 238 | 353 | 2,099 | 7,441 | 4,399 | 319 | 288 | 2,022 | 6,709 |
| Total Texas | 11,026 | 593 | 425 | 2,820 | 14,271 | 8,892 | 618 | 341 | 2,577 | 11,810 |
| West Virginia | 197 | 5 | 650 | 171 | 1,018 | 114 | 13 | 484 | 126 | 724 |
| Wyoming | 72 | 566 | 12 | 43 | 127 | 95 | 480 | 19 | 43 | 157 |
| Other States | ------- | ------- | 54 | 31 | 85 | ------- | ------- | 71 | 26 | 97 |
| Total United States | 22,143 | 480 | [3] 2,834 | 6,420 | 31,397 | 19,121 | 457 | [3] 2,236 | 6,043 | 27,400 |

[1] Oil and Gas Journal, except California. [2] American Petroleum Institute.
[3] Total by States does not agree with total by months published elsewhere in the Yearbook, as former has been revised on basis of annual data from State officials.

*Producing oil wells in the United States and average production per day in 1937, by States and districts* [1]

| State and district | Producing oil wells | | State and district | Producing oil wells | |
|---|---|---|---|---|---|
| | Approximate number, Dec. 31 | Average production per well per day (barrels) | | Approximate number, Dec. 31 | Average production per well per day (barrels) |
| Arkansas | 2,670 | 12.1 | Ohio | 28,500 | 0.3 |
| California [2] | 13,460 | 50.9 | Oklahoma | 55,900 | 11.3 |
| Colorado | 200 | 21.4 | Pennsylvania | 82,800 | .6 |
| Illinois | 14,110 | 1.5 | | | |
| Indiana | 1,240 | 1.9 | Texas: | | |
| Kansas | 21,850 | 9.3 | Gulf Coast | 6,640 | 51.8 |
| Kentucky | 13,700 | 1.1 | East Texas proper | 24,100 | 20.6 |
| | | | West Texas | 7,670 | 32.2 |
| Louisiana: | | | Rest of State | 38,950 | 11.1 |
| Gulf Coast | 1,110 | 167.5 | | | |
| Northern | 3,050 | 26.7 | Total Texas | 77,360 | 19.4 |
| | | | West Virginia | 18,400 | .6 |
| Total Louisiana | 4,160 | 62.6 | Wyoming | 3,350 | 15.5 |
| Michigan | 1,780 | 29.0 | Other States [3] | 130 | ---------- |
| Montana | 1,600 | 10.4 | | | |
| New Mexico | 1,920 | 67.2 | Total wells | 363,030 | 9.8 |
| New York | 19,900 | .8 | | | |

[1] Figures for 1938 not yet available.
[2] American Petroleum Institute.
[3] Missouri, Tennessee, and Utah.

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*Drilling activity in leading districts of the United States, 1937–38* [1]

| District | State | Completions | | District | State | Completions | |
|---|---|---|---|---|---|---|---|
| | | 1937 | 1938 | | | 1937 | 1938 |
| Allegany County [2] | Michigan | 87 | 309 | Fayette County | Illinois | 5 | 518 |
| Barton County | Kansas | 299 | 262 | Lea County | New Mexico | 576 | 469 |
| Bradford-Allegany | Pennsylvania - New York. | 3,810 | 2,168 | Marion County | Illinois | 121 | 693 |
| | | | | Pottawatomie County | Oklahoma | 72 | 174 |
| Caddo Parish | Louisiana | 226 | 134 | Rodessa | Arkansas-Louisiana-Texas. | 286 | 197 |
| Clay County | Illinois | 99 | 153 | | | | |
| Clinton County | do | 27 | 391 | Torrance | California | 19 | 131 |
| Daviess County | Kentucky | 50 | 145 | Union County | Arkansas | 41 | 136 |
| East Texas | Texas | 2,329 | 1,645 | Wichita County | Texas | 392 | 1,033 |
| Ector County | do | 507 | 638 | Wilmington | California | 355 | 263 |
| Fairbanks | do | 5 | 129 | Yoakum County | Texas | 18 | 161 |

[1] Oil and Gas Journal, except Michigan.
[2] Department of Conservation, Michigan.

## STOCKS

The trend of crude-oil stocks in the first quarter of 1938 gave every indication that the experience of 1937 would be repeated—that is, that stocks would be built up. However, drastic revisions in the allowables in April and May resulted in material declines in production. This allowed the expanding demand to catch up so that large withdrawals from stocks were made in May, June, July, and October and smaller ones in August, September, and November. Marked decreases in crude runs to stills during the year and exports in December resulted in an increase in stocks. The total for refinable grades on hand December 31, 1938, was 274,353,000 barrels compared with 305,091,000 on hand the first of the year. These totals are exclusive of stocks of unmixed heavy crude oil in California, segregated from fuel-oil stocks the first of the year, some of which is run to stills each month primarily to produce lubricants and asphalt. These stocks increased from 14,505,000 barrels the first of 1938 to 16,467,000 on December 31.

The net withdrawal from stocks of refinable grades of crude oil in 1938 was more evident in terms of days' supply than in quantity. The low point of days' supply for 1938 was 80, reached October 31—the lowest point in about 20 years.

Refinery stocks changed relatively little in 1938, the total rising about 500,000 barrels to 51,551,000 on December 31. Pipe-line and tank-farm stocks of Pennsylvania Grade crude oil increased materially, which contributed to the market weakness for this grade of oil. Substantial withdrawals were made from all the common grades of Mid-Continent crude oil. In 1938 pipe-line and tank-farm stocks in the Rocky Mountain district fell to the lowest point since 1923. The practice of converting surplus crude into products more easily stored was followed quite generally in California in 1938. However, although this held the increase in crude-oil stocks to under 6,000,000 barrels, stocks of products, mostly residual fuel oil, increased nearly four times that much.

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Significant among the changes in crude-oil stocks by States of origin were the large withdrawals of oil originating in Oklahoma and Texas, an increase in Illinois oil, reflecting the new developments, and heavier reductions from the stocks of old oil in Wyoming. Stocks of foreign crude changed but little during 1938, the total at the close of 1938 being 3,521,000 barrels, or somewhat less than 2 months' supply.

*Stocks of crude petroleum, natural gasoline, and refined products in the United States, at end of year, 1934–38*

[Thousands of barrels]

| | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Crude petroleum (gasoline bearing): | | | | | |
| At refineries | 64,099 | 59,148 | 46,846 | 51,041 | 51,551 |
| Pipe line and tank farm | 264,625 | 245,178 | 230,499 | 244,545<br>[2] 243,552 | 211,931 |
| Producers | 8,530 | 10,529 | 11,234 | 11,240<br>[2] 10,498 | 10,871 |
| Total | [2] 337,254 | [2] 314,855 | [2] 288,579 | [2] 306,826<br>[2] 305,091 | 274,353 |
| California heavy crude (nongasoline bearing) | [3] | [3] | [3] | [2] 14,505 | 16,467 |
| Total crude petroleum | [2] 337,254 | [2] 314,855 | [2] 288,579 | [2] 306,826<br>[2] 319,596 | 290,820 |
| Natural gasoline | 4,216 | 3,698 | 4,055 | 4,758 | 4,830 |
| Refined products [4] | [2] 222,682 | [2] 223,361 | [2] 226,595 | [2] 253,413<br>[2] 239,632 | 259,613 |
| Grand total | 564,152 | 541,914 | 519,229 | 564,997<br>[2] 563,986 | 555,263 |

[1] Subject to revision.
[2] For comparison with succeeding year.
[3] California heavy crude and fuel oil included under refined products as residual fuel oil.
[4] Data not available.
[5] Includes also equivalents for wax, coke, and asphalt in barrels.

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*Stocks of crude petroleum in the United States in 1938, by States of location and origin and by months* [1]

[Thousands of barrels]

| State | Jan. 1 | Jan. 31 | Feb. 28 | Mar. 31 | Apr. 30 | May 31 | June 30 | July 31 | Aug. 31 | Sept. 30 | Oct. 31 | Nov. 30 | Dec. 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | | | | | | | | | | |
| Arkansas | 2,541 | 2,441 | 2,655 | 2,659 | 2,673 | 2,557 | 2,310 | 2,291 | 2,415 | 2,332 | 2,278 | 2,291 | 2,447 |
| California | 29,414 | 29,296 | 31,145 | 31,579 | 31,392 | 31,488 | 32,925 | 32,895 | 33,278 | 33,670 | 34,764 | 35,975 | 37,064 |
| Illinois | 10,913 | 11,340 | 11,356 | 10,998 | 11,357 | 11,501 | 11,511 | 11,725 | 11,608 | 11,631 | 11,598 | 11,311 | 11,752 |
| Indiana | 2,962 | 3,031 | 3,120 | 3,271 | 3,198 | 3,048 | 3,018 | 3,127 | 3,231 | 3,206 | 3,133 | 3,198 | 3,190 |
| Kansas | 10,715 | 10,885 | 10,741 | 10,694 | 10,963 | 10,189 | 9,779 | 8,935 | 8,841 | 8,687 | 8,654 | 8,301 | 7,936 |
| Louisiana and Alabama | 11,848 | 12,047 | 11,531 | 11,095 | 11,383 | 11,041 | 11,375 | 11,995 | 12,772 | 13,096 | 13,390 | 12,679 | 11,622 |
| Maryland [2] | 2,882 | 2,501 | 2,839 | 2,731 | 2,280 | 2,627 | 2,516 | 2,529 | 2,215 | 2,248 | 2,007 | 2,163 | 2,347 |
| Michigan and Kentucky | 1,740 | 1,743 | 1,850 | 2,035 | 2,171 | 2,158 | 2,076 | 2,035 | 2,007 | 1,978 | 2,208 | 2,131 | 2,320 |
| Missouri and Iowa | 4,000 | 4,122 | 4,077 | 4,183 | 4,055 | 4,088 | 4,239 | 4,172 | 4,108 | 4,098 | 4,047 | 3,839 | 3,965 |
| Montana and Colorado | 1,949 | 1,932 | 1,886 | 1,880 | 2,033 | 2,076 | 2,064 | 2,131 | 2,111 | 1,929 | 1,970 | 2,050 | 2,064 |
| New Jersey | 6,294 | 6,917 | 7,216 | 7,691 | 7,803 | 6,916 | 5,877 | 6,610 | 5,888 | 5,660 | 5,287 | 5,299 | 5,842 |
| New Mexico | 1,114 | 1,143 | 1,126 | 1,150 | 1,193 | 1,158 | 1,145 | 1,295 | 1,216 | 1,172 | 1,196 | 1,274 | 1,238 |
| New York | 1,150 | 1,163 | 1,047 | 1,239 | 1,005 | 1,034 | 1,153 | 1,239 | 1,125 | 1,297 | 1,207 | 1,239 | 1,149 |
| Ohio | 8,057 | 8,218 | 7,871 | 8,196 | 8,265 | 8,295 | 8,457 | 8,216 | 8,184 | 8,279 | 8,201 | 8,105 | 8,095 |
| Oklahoma | 70,823 | 71,511 | 72,012 | 72,906 | 71,834 | 69,397 | 66,504 | 63,416 | 60,886 | 59,390 | 57,038 | 54,864 | 53,506 |
| Pennsylvania | 6,544 | 6,604 | 6,674 | 7,035 | 7,251 | 7,024 | 7,264 | 6,965 | 6,808 | 6,708 | 5,932 | 5,949 | 6,630 |
| Texas | 107,388 | 106,602 | 104,573 | 105,425 | 104,064 | 100,608 | 97,113 | 96,713 | 97,185 | 95,459 | 93,018 | 91,690 | 92,403 |
| West Virginia | 2,151 | 2,232 | 2,182 | 2,224 | 2,224 | 2,305 | 2,369 | 2,390 | 2,402 | 2,440 | 2,454 | 2,410 | 2,338 |
| Wyoming [3] | 22,606 | 22,467 | 22,448 | 22,412 | 22,153 | 21,473 | 20,939 | 19,985 | 19,360 | 18,856 | 18,425 | 18,387 | 18,445 |
| Total United States | 305,091 | 306,195 | 306,349 | 309,403 | 307,297 | 298,983 | 292,634 | 288,664 | 285,640 | 282,136 | 276,807 | 273,155 | 274,353 |
| ORIGIN | | | | | | | | | | | | | |
| Arkansas | 3,706 | 3,664 | 3,934 | 3,962 | 3,932 | 3,735 | 3,393 | 2,967 | 3,017 | 3,093 | 2,962 | 2,937 | 3,089 |
| California | 29,459 | 29,341 | 31,188 | 31,669 | 31,504 | 31,624 | 33,151 | 33,138 | 33,548 | 33,975 | 34,999 | 36,064 | 37,193 |
| Illinois and Indiana | 9,913 | 9,817 | 9,735 | 9,913 | 10,227 | 10,403 | 10,421 | 10,618 | 10,657 | 11,040 | 11,102 | 11,274 | 11,403 |
| Kansas | 6,478 | 6,889 | 7,101 | 7,082 | 7,000 | 6,254 | 6,384 | 6,164 | 6,347 | 6,269 | 6,324 | 6,683 | 6,861 |
| Louisiana | 12,953 | 13,378 | 13,302 | 13,623 | 13,358 | 13,021 | 13,822 | 14,197 | 14,416 | 14,852 | 15,185 | 14,173 | 13,806 |
| Michigan and Kentucky | 2,038 | 2,083 | 1,961 | 2,150 | 2,245 | 2,338 | 2,414 | 2,245 | 2,120 | 2,133 | 2,352 | 2,074 | 2,377 |
| Montana and Colorado | 1,894 | 1,899 | 1,867 | 1,867 | 2,029 | 2,050 | 2,021 | 2,072 | 2,043 | 1,888 | 1,942 | 1,952 | 1,909 |
| New Mexico | 10,178 | 9,959 | 9,472 | 9,075 | 9,438 | 9,125 | 8,549 | 7,732 | 7,862 | 7,830 | 7,764 | 7,468 | 7,358 |
| Ohio | 893 | 868 | 982 | 973 | 899 | 859 | 892 | 944 | 893 | 877 | 800 | 797 | 756 |
| Oklahoma | 90,513 | 91,216 | 91,160 | 91,466 | 90,794 | 88,066 | 84,338 | 81,234 | 78,945 | 77,667 | 74,829 | 71,692 | 70,073 |
| Pennsylvania, New York, and West Virginia | 4,846 | 4,807 | 4,830 | 5,091 | 5,179 | 5,361 | 5,504 | 5,593 | 5,679 | 5,681 | 5,649 | 5,494 | 5,422 |
| Texas | 105,691 | 105,636 | 104,432 | 105,845 | 104,628 | 100,888 | 97,055 | 97,609 | 97,275 | 94,852 | 91,342 | 90,921 | 91,565 |
| Wyoming | 23,034 | 22,906 | 22,890 | 22,883 | 22,518 | 21,945 | 21,579 | 20,760 | 20,122 | 19,439 | 19,040 | 18,989 | 19,020 |
| Foreign | 3,495 | 3,732 | 3,495 | 3,804 | 3,546 | 3,314 | 3,111 | 3,391 | 2,716 | 2,540 | 2,517 | 2,637 | 3,521 |
| Total United States | 305,091 | 306,195 | 306,349 | 309,403 | 307,297 | 298,983 | 292,634 | 288,664 | 285,640 | 282,136 | 276,807 | 273,155 | 274,353 |

[1] Subject to revision. [2] Includes Delaware, Georgia, Massachusetts, Rhode Island, South Carolina, and Virginia. [3] Includes Nebraska, South Dakota, and Utah.

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*Stocks of crude petroleum in the United States, in 1938, by districts and months* [1]

[Thousands of barrels]

| District | Jan. 1 | Jan. 31 | Feb. 28 | Mar. 31 | Apr. 30 | May 31 | June 30 | July 31 | Aug. 31 | Sept. 30 | Oct. 31 | Nov. 30 | Dec. 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| At refineries, by fields of origin: | | | | | | | | | | | | | |
| Appalachian: | | | | | | | | | | | | | |
| Pennsylvania Grade | 833 | 730 | 741 | 777 | 783 | 780 | 710 | 803 | 829 | 879 | 849 | 846 | 765 |
| Other Appalachian (including Kentucky) | 388 | 433 | 430 | 422 | 449 | 507 | 480 | 473 | 455 | 387 | 454 | 457 | 496 |
| Lima-Northeastern Indiana-Michigan | 560 | 499 | 373 | 419 | 363 | 449 | 590 | 447 | 360 | 439 | 466 | 454 | 515 |
| Illinois-Southwestern Indiana | 163 | 148 | 206 | 171 | 320 | 321 | 328 | 315 | 436 | 535 | 482 | 564 | 659 |
| North Louisiana and Arkansas | 3,375 | 3,385 | 3,766 | 3,812 | 3,735 | 3,440 | 3,652 | 2,848 | 3,034 | 3,157 | 2,497 | 1,979 | 2,244 |
| West Texas and Southeastern New Mexico | 4,858 | 5,519 | 5,810 | 5,439 | 5,125 | 5,194 | 5,276 | 4,531 | 4,119 | 4,029 | 3,905 | 4,195 | 3,800 |
| East Texas | 4,224 | 5,060 | 4,980 | 5,182 | 5,283 | 5,279 | 4,266 | 4,065 | 4,165 | 3,731 | 3,421 | 2,924 | 3,061 |
| Oklahoma, Kansas, North Texas, etc. | 13,726 | 14,315 | 13,470 | 14,012 | 14,651 | 13,881 | 13,680 | 14,347 | 14,655 | 14,926 | 14,934 | 14,465 | 14,130 |
| Gulf Coast | 8,937 | 9,029 | 9,662 | 9,560 | 9,478 | 9,580 | 9,755 | 10,198 | 9,851 | 10,252 | 9,411 | 9,854 | 10,000 |
| Rocky Mountain | 2,227 | 2,254 | 2,295 | 2,224 | 2,242 | 2,356 | 2,466 | 2,256 | 2,104 | 2,104 | 2,195 | 2,011 | 2,030 |
| California | 8,255 | 7,805 | 8,187 | 7,638 | 8,376 | 8,141 | 8,614 | 7,900 | 8,997 | 8,003 | 9,292 | 9,743 | 10,330 |
| Foreign | 3,495 | 3,732 | 3,495 | 3,804 | 3,546 | 3,314 | 3,111 | 3,391 | 2,716 | 2,540 | 2,517 | 2,637 | 3,521 |
| Total at refineries | 51,041 | 52,909 | 53,415 | 53,460 | 54,351 | 53,242 | 52,928 | 51,574 | 51,721 | 50,982 | 50,423 | 50,129 | 51,551 |
| Pipe-line and tank-farm stocks, by fields of origin: | | | | | | | | | | | | | |
| Appalachian: | | | | | | | | | | | | | |
| Pennsylvania Grade | 4,011 | 4,084 | 4,116 | 4,325 | 4,424 | 4,583 | 4,823 | 4,839 | 4,928 | 4,885 | 4,841 | 4,696 | 4,678 |
| Other Appalachian (including Kentucky) | 710 | 648 | 680 | 739 | 814 | 841 | 899 | 890 | 877 | 843 | 816 | 760 | 726 |
| Lima-Northeastern Indiana-Michigan | 797 | 881 | 950 | 1,059 | 1,017 | 923 | 828 | 850 | 773 | 778 | 890 | 662 | 880 |
| Illinois-Southwestern Indiana | 9,587 | 9,486 | 9,351 | 9,594 | 9,729 | 9,892 | 9,913 | 10,108 | 10,021 | 10,305 | 10,390 | 10,430 | 10,484 |
| North Louisiana and Arkansas | 6,077 | 6,241 | 6,069 | 6,202 | 6,061 | 5,686 | 5,836 | 6,066 | 5,905 | 5,884 | 6,045 | 6,033 | 5,521 |
| West Texas and Southeastern New Mexico | 26,851 | 25,656 | 24,590 | 25,065 | 24,487 | 23,280 | 21,604 | 21,134 | 20,353 | 20,590 | 19,821 | 19,572 | 19,757 |
| East Texas | 22,959 | 22,078 | 23,106 | 22,724 | 22,565 | 20,040 | 18,535 | 18,604 | 18,962 | 17,521 | 15,921 | 15,644 | 15,698 |
| Oklahoma, Kansas, North Texas, etc. | 115,027 | 115,522 | 115,514 | 116,063 | 115,495 | 112,074 | 107,975 | 104,882 | 102,782 | 100,700 | 97,430 | 94,146 | 93,921 |
| Gulf Coast | 16,804 | 17,020 | 15,559 | 15,784 | 15,346 | 15,472 | 15,692 | 16,095 | 16,915 | 16,884 | 17,812 | 17,903 | 17,776 |
| Rocky Mountain | 22,397 | 22,258 | 22,182 | 22,261 | 22,029 | 21,367 | 20,794 | 20,219 | 19,712 | 18,882 | 18,366 | 18,509 | 18,478 |
| California [2] | 18,332 | 18,030 | 19,091 | 19,629 | 19,904 | 20,446 | 21,520 | 22,210 | 21,631 | 23,068 | 22,794 | 23,241 | 24,012 |
| Total pipe-line and tank-farm | 243,552 | 241,904 | 241,208 | 243,445 | 241,871 | 234,604 | 228,419 | 225,897 | 222,859 | 220,340 | 215,126 | 211,596 | 211,931 |
| Producers' stocks | 10,498 | 11,382 | 11,726 | 12,498 | 11,075 | 11,137 | 11,287 | 11,193 | 11,060 | 10,814 | 11,258 | 11,430 | 10,871 |
| Total United States: 1938 [3] | 305,091 | 306,195 | 306,349 | 309,403 | 307,297 | 298,983 | 292,634 | 288,664 | 285,640 | 282,136 | 276,807 | 273,155 | 274,353 |
| 1937 [3] | 288,579 | 287,159 | 290,372 | 297,896 | 304,706 | 308,719 | 309,313 | 309,231 | 311,440 | 310,271 | 309,165 | 306,457 | 306,826 |

[1] Subject to revision.

[2] Excludes stocks of California heavy crude as follows (thousands of barrels): Jan. 1, 14,505; Jan. 31, 15,026; Feb. 28, 15,563; Mar. 31, 16,069; Apr. 30, 16,887; May 31, 17,353; June 30, 17,425; July 31, 17,646; Aug. 31, 17,575; Sept. 30, 17,535; Oct. 31, 17,143; Nov. 30, 16,765; Dec. 31, 16,467. Data not available prior to 1938.

[3] Revisions of preliminary figures for 1937 (Minerals Yearbook, 1938, p. 840) are as follows (thousands of barrels): Refinery stocks, July 31, California 8,051, total 56,100; pipe-line and tank-farm stocks, July 31, Pennsylvania Grade, 3,639; West Texas and Southeastern New Mexico, 25,787; Oklahoma, Kansas, North Texas, etc., 113,850; Rocky Mountain, 22,813; and producers' stocks, Jan. 1, 11,234; Jan. 31, 11,708; Feb. 28, 11,304; Mar. 31, 11,451; Apr. 30, 11,115; May 31, 11,311; June 30, 11,267; July 31, 11,360; Aug. 31, 11,460; Sept. 30, 11,466; Oct. 31, 11,610; Nov. 30, 11,498; Dec. 31, 11,240.

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## CONSUMPTION AND DISTRIBUTION

*Runs to stills.*—Total crude run to stills in 1938 declined over 18 million barrels from the record of 1,183 million barrels in 1937. The decrease was all in domestic crude runs as foreign crude runs remained virtually unchanged. Imports of Mexican crude were almost 2 million barrels less than in 1937, and imports from Venezuela increased slightly.

Crude runs in the Texas Gulf Coast district rose to 308 million barrels, an increase of 26 million barrels (9 percent) over 1937. The continued upward trend in this district presented the effects of increased refinery capacity and the very active export demand for refined products in 1938. The only other increase in runs was in the Rocky Mountain district a gain of 6 percent over 1937. All other districts declined from 1937. Compared to 1937 runs in the Texas Inland district decreased 11 percent, the East Coast district 9 percent, the Oklahoma, Kansas, and Missouri district 8 percent, the Louisiana Louisiana Gulf Coast district 8 percent, the Appalachian and Arkansas and Louisiana Inland districts 3 percent, and the Indiana, Illinois, Kentucky, and California districts 1 percent.

The material recession in the domestic demand for residual fuel oil was an important factor in the decrease in the runs to stills in 1938. Furthermore, efforts were being made in most districts east of California to liquidate the excess stocks of refined products accumulated in 1937. Many smaller refineries in inland locations were inoperative because of the relatively greater decline in the price of finished products compared to the price of crude petroleum. In California, the large increase in the stocks of finished oils, particularly residual fuel, indicated that runs were maintained at a far higher rate than demand warranted.

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*Runs to stills of crude petroleum in the United States in 1938, by districts and months*

[Thousands of barrels]

| District | January | February | March | April | May | June | July | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East Coast: | | | | | | | | | | | | | |
| Domestic | 13,947 | 12,352 | 12,987 | 12,695 | 12,931 | 12,491 | 12,709 | 13,378 | 12,926 | 13,734 | 13,069 | 13,254 | 156,473 |
| Foreign | 1,799 | 2,098 | 2,194 | 2,011 | 2,195 | 2,259 | 2,202 | 2,240 | 1,557 | 2,254 | 1,803 | 1,521 | 24,133 |
| Total East Coast | 15,746 | 14,450 | 15,181 | 14,706 | 15,126 | 14,750 | 14,911 | 15,618 | 14,483 | 15,988 | 14,872 | 14,775 | 180,606 |
| Appalachian | 3,449 | 3,174 | 3,039 | 3,208 | 3,383 | 3,251 | 3,360 | 3,344 | 3,175 | 3,260 | 3,143 | 3,394 | 39,180 |
| Indiana, Illinois, Kentucky, etc | 13,567 | 12,358 | 12,921 | 12,624 | 13,229 | 12,914 | 13,955 | 13,810 | 14,095 | 15,225 | 14,369 | 14,073 | 163,140 |
| Oklahoma, Kansas, and Missouri | 8,716 | 8,038 | 8,985 | 9,233 | 10,178 | 9,537 | 10,261 | 10,007 | 9,412 | 9,144 | 8,752 | 8,880 | 111,143 |
| Texas Inland | 5,906 | 5,449 | 5,314 | 5,512 | 5,412 | 5,566 | 5,932 | 5,875 | 5,661 | 5,491 | 5,716 | 5,089 | 66,923 |
| Texas Gulf Coast: | | | | | | | | | | | | | |
| Domestic | 25,195 | 22,464 | 25,106 | 25,521 | 26,278 | 25,101 | 26,088 | 26,992 | 25,032 | 26,068 | 25,750 | 26,744 | 306,339 |
| Foreign | 1 | 19 | 21 | ---------- | 18 | 37 | 36 | 66 | 158 | 370 | 426 | 415 | 1,567 |
| Total Texas Gulf Coast | 25,196 | 22,483 | 25,127 | 25,521 | 26,296 | 25,138 | 26,124 | 27,058 | 25,190 | 26,438 | 26,176 | 27,159 | 307,906 |
| Louisiana Gulf Coast: | | | | | | | | | | | | | |
| Domestic | 4,222 | 3,612 | 4,183 | 3,887 | 4,271 | 3,426 | 3,826 | 3,854 | 3,548 | 3,805 | 3,855 | 3,927 | 46,416 |
| Foreign | 44 | 3 | 26 | 59 | 19 | 78 | 41 | 30 | 42 | 84 | 10 | 51 | 487 |
| Total Louisiana Gulf Coast | 4,266 | 3,615 | 4,209 | 3,946 | 4,290 | 3,504 | 3,867 | 3,884 | 3,590 | 3,889 | 3,865 | 3,978 | 46,903 |
| Arkansas and Louisiana Inland | 1,955 | 1,681 | 1,882 | 2,087 | 2,180 | 1,851 | 1,962 | 1,983 | 1,917 | 2,467 | 2,071 | 2,053 | 24,089 |
| Rocky Mountain | 1,962 | 1,739 | 1,889 | 1,800 | 2,118 | 2,129 | 2,319 | 2,579 | 2,269 | 2,102 | 1,997 | 1,888 | 24,791 |
| California | 17,137 | 15,192 | 17,338 | 17,038 | 17,026 | 15,240 | 17,165 | 17,194 | 17,198 | 16,783 | 16,348 | 16,675 | 200,334 |
| Total domestic | 96,056 | 86,059 | 93,644 | 93,605 | 97,006 | 91,506 | 97,577 | 99,016 | 95,233 | 98,079 | 95,070 | 95,977 | 1,138,828 |
| Total foreign | 1,844 | 2,120 | 2,241 | 2,070 | 2,232 | 2,374 | 2,279 | 2,336 | 1,757 | 2,708 | 2,239 | 1,987 | 26,187 |
| Total United States | 97,900 | 88,179 | 95,885 | 95,675 | 99,238 | 93,880 | 99,856 | 101,352 | 96,990 | 100,787 | 97,309 | 97,964 | 1,165,015 |
| Daily average | 3,158 | 3,149 | 3,093 | 3,189 | 3,201 | 3,129 | 3,221 | 3,269 | 3,233 | 3,251 | 3,244 | 3,160 | 3,192 |

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*Distribution.*—Receipts of domestic and foreign crude petroleum at refineries in the United States totaled 1,073 million barrels in 1936 and 1,191 million in 1937, but dropped to 1,167 million in 1938. Interstate receipts of domestic crude were 445 million barrels in 1938, compared to 487 million in 1937. This represented a relative decline in interstate shipments from 41 percent of the total receipts in 1937 to 38 percent in 1938. Intrastate receipts of domestic crude amounted to 696 million barrels in 1938 (60 percent of the total) compared with 676 million barrels (57 percent of the total) in 1937. Receipts of foreign crude fell 1 million barrels. The increase in the relative proportion of intrastate receipts continued the trend of recent years and reflects the growth in the local refining of Texas production in the Gulf Coast district. However, the trend was accentuated by a decline in runs in the East Coast district and the maintenance of excessive runs in California.

Refinery receipts of crude in 1938, by methods of transportation, indicated that 73 percent of the total was delivered by pipe lines, 24 percent by boat, and 3 percent by tank car and truck. Compared to 1937 the percentage of pipe-line shipments increased 2 percent, while shipments by boat dropped by about the same amount. The most important boat movement of crude is from Gulf ports to the East Coast. These shipments decreased from 171 million barrels in 1937 to 151 million in 1938.

Exports of domestic crude have increased steadily in recent years. The 77 million barrels exported in 1938 represented an increase of 10 million over 1937. Texas was the largest exporter in 1938, with 34 million barrels, followed by California, with 28 million, and Oklahoma, with 12 million.

Approximately 39 percent of the total movement of domestic crude petroleum from producing fields to refineries was interstate and 61 percent intrastate.

*Receipts of crude petroleum at refineries in the United States, 1934–38, by methods of transportation*

[Millions of barrels]

| | 1934 [1] | 1935 | 1936 [1] | 1937 | 1938 [2] |
|---|---|---|---|---|---|
| By boat: | | | | | |
| Intrastate | 42.4 | 55.4 | 68.6 | 78.5 | 74.1 |
| Interstate | 154.5 | 164.9 | 184.9 | 201.8 | 182.8 |
| Foreign | 35.6 | 32.2 | 32.3 | 27.5 | 26.4 |
| Total by boat | 232.5 | 252.5 | 285.8 | 307.8 | 283.3 |
| By pipe lines: | | | | | |
| Intrastate | 433.2 | 466.2 | 517.3 | 569.6 | 600.1 |
| Interstate | 206.0 | 220.9 | 247.2 | 276.7 | 254.3 |
| Total by pipe lines | 639.2 | 687.1 | 764.5 | 846.3 | 854.4 |
| By tank car and truck: | | | | | |
| Intrastate | 18.4 | 15.7 | 14.6 | 28.2 | 21.9 |
| Interstate | 7.9 | 9.7 | 7.6 | 8.5 | 7.8 |
| Total by tank car and truck | 26.3 | 25.4 | 22.2 | 36.7 | 29.7 |
| Grand total | 898.0 | 965.0 | 1,072.5 | 1,190.8 | 1,167.4 |

[1] Revised figuree.
[2] Subject to revision.

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*Summary of crude petroleum receipts and consumption at refineries in the United States in 1938, by consuming States* [1]

[Thousands of barrels]

| Consuming State | Origin of receipts | | | | | | Change in refinery stocks | Crude runs to stills | Fuel and losses |
|---|---|---|---|---|---|---|---|---|---|
| | Intrastate | Interstate | | | | Foreign | | | |
| | | Oklahoma | Texas | Other States | Total | | | | |
| Arkansas | 9,654 | ---- | 22 | 6 | 28 | ---- | −251 | 9,950 | −17 |
| California | 202,875 | ---- | ---- | ---- | ---- | ---- | 1,991 | 200,334 | 550 |
| Colorado | 1,312 | ---- | ---- | 405 | 405 | ---- | −67 | 1,773 | 11 |
| Georgia [2] | ---- | ---- | 3 | 115 | 118 | 1,833 | −214 | 2,165 | ---- |
| Illinois | 8,027 | 20,950 | 2,406 | 15,682 | 39,038 | ---- | 34 | 46,996 | 35 |
| Indiana | 4 | 40,986 | 4,938 | 21,748 | 67,672 | ---- | 225 | 67,452 | −1 |
| Kansas | 33,305 | 13,148 | 72 | ---- | 13,220 | ---- | −400 | 46,912 | 13 |
| Kentucky [3] | 5,829 | 200 | ---- | 2,129 | 2,329 | ---- | 117 | 8,034 | 7 |
| Louisiana [4] | 29,510 | 277 | 25,098 | 5,346 | 30,721 | 482 | −663 | 61,042 | 334 |
| Maryland | ---- | ---- | 6,776 | 3,495 | 10,271 | 2,253 | −113 | 12,525 | 112 |
| Massachusetts [5] | ---- | ---- | 10,342 | 613 | 10,955 | 1,146 | −208 | 12,286 | 23 |
| Michigan | 11,760 | 3,756 | ---- | 113 | 3,869 | ---- | 59 | 15,556 | 14 |
| Missouri | ---- | 2,030 | 170 | 4,486 | 6,686 | ---- | −3 | 6,689 | ---- |
| Montana | 4,122 | ---- | ---- | 1,639 | 1,639 | ---- | 24 | 5,729 | 8 |
| New Jersey | ---- | 4,371 | 37,074 | 20,111 | 61,556 | 6,721 | −609 | 68,656 | 230 |
| New Mexico | 1,431 | ---- | 394 | ---- | 394 | ---- | 2 | 1,814 | 9 |
| New York: | | | | | | | | | |
| East | ---- | ---- | 5,519 | ---- | 5,519 | 3,079 | −70 | 8,667 | 1 |
| West | 3,606 | 2,479 | ---- | 1,026 | 3,505 | ---- | 57 | 7,053 | 1 |
| Ohio: | | | | | | | | | |
| East | 1,751 | 3,128 | ---- | 7,111 | 10,239 | ---- | 46 | 11,942 | 2 |
| West | 569 | 14,796 | 420 | 9,297 | 24,513 | ---- | −4 | 25,102 | −16 |
| Oklahoma | 54,884 | ---- | 29 | 2,638 | 2,667 | ---- | −131 | 57,542 | 140 |
| Pennsylvania: | | | | | | | | | |
| East | 31 | 5,622 | 52,794 | 8,655 | 67,071 | 9,262 | −5 | 76,307 | 62 |
| West | 14,468 | 1,797 | ---- | 844 | 2,641 | ---- | −133 | 17,232 | 10 |
| Texas | 298,939 | 15,092 | ---- | 60,432 | 75,524 | 1,636 | 988 | 374,829 | 282 |
| Utah | ---- | ---- | 255 | 2,743 | 2,998 | ---- | 124 | 2,874 | ---- |
| West Virginia | 1,786 | 647 | ---- | 500 | 1,147 | ---- | −21 | 2,953 | 1 |
| Wyoming [6] | 12,238 | ---- | ---- | 132 | 132 | ---- | −265 | 12,601 | 34 |
| Total United States | 696,101 | 129,279 | 146,312 | 169,266 | 444,857 | 26,412 | 510 | 1,165,015 | 1,845 |
| Daily average | 1,907 | 354 | 401 | 464 | 1,219 | 72 | 1 | 3,192 | 5 |

[1] Subject to revision.
[2] Includes Delaware, South Carolina, and Virginia.
[3] Includes Tennessee.
[4] Includes Alabama.
[5] Includes Rhode Island.
[6] Includes Idaho, Nebraska, and South Dakota.

Receipts of crude petroleum at refineries represent the principal data for determining the trend of market demand by States. In 1938 Texas, Oklahoma, California, Louisiana, Kansas, and New Mexico supplied about 90 percent of the refinery receipts of domestic crude compared to 92 percent in 1937.

Total refinery receipts of Texas crude decreased by 15 million barrels—from 460 million in 1937 to 445 million in 1938. Deliveries to refineries in Texas amounted to 299 million barrels (67 percent of the total) and increased almost 19 million barrels over 1937, while deliveries to refineries in other States declined by 33 million barrels. These figures indicate continuance of the trend to refine a larger proportion of State production in the Texas Gulf district. Exports of Texas crude amounted to about 34 million barrels, a gain of 4 million from 1937.

Domestic refinery receipts of Oklahoma crude decreased by 23 million barrels—from 207 million in 1937 to 184 million in 1938. Deliveries to Oklahoma refineries declined by only 4 million barrels compared to a decrease of 19 million barrels to other States. Exports of Oklahoma crude totaled about 12 million barrels, an increase of

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over 3 million from 1937. The sharp decline in State production, although partly offset by a considerable liquidation of accumulated stocks of Oklahoma origin, indicates a relative decline in the market position of Oklahoma crude.

The deliveries of California crude to domestic refineries decreased slightly—from 206 million barrels in 1937 to 204 million in 1938. Normally, shipments are all intrastate, but in 1938 about 1 million barrels went to the East Coast district. The large increases in stocks of refined oils indicate that runs to stills were considerably above actual requirements. Exports of crude petroleum rose from 23 million barrels in 1937 to almost 28 million in 1938.

*Receipts of crude petroleum by refinery districts, 1937–38, by States of origin*

[Thousands of barrels

| Refinery district | State of origin | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Texas | | Oklahoma | | Louisiana | | Kansas | | New Mexico | |
| | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 | 1937 | 1938 |
| East Coast | 126,674 | 112,508 | 12,534 | 9,993 | 19,043 | 16,933 | | | 9,042 | 10,237 |
| Appalachian | 160 | | 13,034 | 8,051 | | | | | | |
| Indiana, Illinois, Kentucky, etc. | 12,474 | 7,764 | 85,795 | 80,688 | 255 | 217 | 26,727 | 24,189 | 10,260 | 10,288 |
| Oklahoma, Kansas, and Missouri | 2,338 | 271 | 76,823 | 70,062 | | | 40,109 | 36,479 | | |
| Texas Inland | 71,898 | 62,912 | 1,073 | 1,240 | 670 | 481 | | | 2,184 | 2,049 |
| Texas Gulf Coast | 208,544 | 236,027 | 17,201 | 13,852 | 40,497 | 37,312 | | | 14,953 | 19,986 |
| Louisiana Gulf Coast | 26,314 | 19,213 | 434 | 277 | 19,451 | 22,877 | | | 1,714 | 267 |
| Arkansas and Louisiana Inland | 11,143 | 5,907 | | | 5,370 | 6,639 | | | | |
| Rocky Mountain | 500 | 649 | | | | | | | 1,478 | 1,455 |
| Total United States | 460,045 | 445,251 | 206,894 | 184,163 | 85,286 | 84,459 | 66,836 | 60,668 | 39,631 | 44,282 |

There was little change in 1938 in the demand for Louisiana crude, as deliveries to domestic refineries continued at about 85 million barrels, and exports of crude were virtually the same as in 1937. An increase of 5 million barrels in crude delivered to refineries within the State about offset the decline in interstate shipments to other districts.

The market for Kansas crude declined, owing to the rise in production in Illinois and to eastward shipments from Wyoming. Deliveries of Kansas crude to refineries fell from 67 million barrels in 1937 to 61 million in 1938, and the decrease was divided about equally between intrastate and interstate deliveries.

The market for New Mexico crude continued to increase, but at a slower rate. Deliveries to refineries rose in 1938 to about 44 million barrels, an increase of 5 million. This increase was all in interstate shipments and mainly to the Texas Gulf Coast refinery district.

The total production of crude petroleum in Illinois rose to about 24 million barrels in 1938, an increase of about 16 million barrels. Deliveries of crude to refineries within the State rose from 5 to 8 million barrels, and large additional shipments were made to refineries in adjacent States. The rapid expansion in the supply of Illinois crude was a serious competitive factor in the markets formerly supplied by crude from more distant sources.

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*Distribution of crude petroleum in the United States in 1938, by States* [1]

[Thousands of barrels]

| State | Production | Imports | Receipts from other States: Quantity | Receipts from other States: State | Runs to stills | Exports | Deliveries to other States: Quantity | Deliveries to other States: State | Net changes in total crude stocks by location |
|---|---|---|---|---|---|---|---|---|---|
| Arkansas | 18,077 | ------ | 28 | La. and Tex | 9,950 | ------ | 5,683 | La., N. J., Pa., and Tex | −94 |
| California | 249,749 | ------ | ------ | ------ | 200,334 | 27,604 | 923 | N. J., and Pa | 9,612 |
| Colorado | 1,412 | ------ | 405 | N. Mex. and Wyo | 1,773 | ------ | 712 | Utah | 32 |
| Georgia [2] | ------ | 1,833 | 118 | ------ | 2,165 | ------ | ------ | ------ | −214 |
| Illinois | 23,929 | ------ | 39,038 | Ind., Kans., Ky., La., N. Mex., Okla., and Tex. | 46,996 | 530 | 12,133 | Ky. and Ohio | 839 |
| Indiana | 969 | ------ | 67,672 | Kans., La., N. Mex., Okla., Tex., and Wyo | 67,452 | ------ | 998 | Ill. and Ky | 228 |
| Kansas | 59,587 | ------ | 13,220 | Okla. and Tex | 46,912 | ------ | 27,363 | Ill., Ind., Mo., and Okla | −2,779 |
| Kentucky-Tennessee. | 5,853 | ------ | 2,329 | Ill., Ind., and Okla | 8,034 | ------ | ------ | Ill | 191 |
| Louisiana | 94,812 | 482 | [3] 30,721 | Ark., N. Mex., Okla., and Tex | [3] 61,042 | 2,400 | 54,949 | Ark., Ill., Ind., Md., N. J., Ohio, Pa., and Tex. | [3] −226 |
| Maryland | ------ | 2,253 | 10,271 | La., N. Mex., and Tex | 12,525 | ------ | ------ | ------ | −113 |
| Massachusetts [4] | ------ | 1,146 | 10,955 | N. Mex. and Tex | 12,286 | ------ | ------ | ------ | −208 |
| Michigan | 19,211 | ------ | 3,869 | Okla | 15,556 | ------ | 7,236 | Ohio | 389 |
| Missouri | [5] 36 | ------ | 6,686 | Kans., Okla., Tex., and Wyo | 6,689 | ------ | ------ | ------ | −13 |
| Montana | 4,907 | ------ | 1,639 | Wyo | 5,729 | 356 | 288 | Wyo | 83 |
| New Jersey | ------ | 6,721 | 61,556 | Ark., Calif., La., N. Mex., N. Y., Okla., Pa., Tex., and W. Va. | 68,656 | ------ | ------ | ------ | −452 |
| New Mexico | 35,759 | ------ | 394 | Tex | 1,814 | 353 | 42,851 | Colo., Ill., Ind., La., Md., Mass., N. J., Pa., Tex., and Utah. | 124 |
| New York | 5,045 | 3,079 | 9,024 | Okla., Pa., and Tex | 15,720 | ------ | 252 | N. J. and Pa | −1 |
| Ohio | 3,298 | ------ | 34,752 | Ill., La., Mich., Okla., Tex., and W. Va | 37,044 | ------ | 450 | Pa. and W. Va | 38 |
| Oklahoma | 174,882 | ------ | 2,667 | Kans. and Tex | 57,542 | 12,188 | 129,279 | Ill., Ind., Kans., Ky., La., Mich., Mo., N. J., N. Y., Ohio, Pa., Tex., and W. Va. | −17,317 |
| Pennsylvania | 17,426 | 9,262 | 69,712 | Ark., Calif., La., N. Mex., N. Y., Ohio, Okla., Tex., and W. Va. | 93,539 | ------ | 4,976 | N. J. and N. Y | 86 |
| Texas | 475,614 | 1,636 | 75,524 | Ark., La., N. Mex., and Okla | 374,829 | 33,711 | 146,312 | Ala., Ark., Ill., Ind., Kans., La., Md., Mass., Mo., N. J., N. Mex., N. Y., Ohio, Okla., Pa., R. I., and Utah. | −14,985 |
| Utah | [6] | ------ | 2,998 | Colo., N. Mex., Tex., and Wyo | 2,874 | ------ | ------ | ------ | 124 |
| West Virginia | 3,684 | ------ | 1,147 | Ohio and Okla | 2,953 | ------ | 1,077 | N. J., Ohio, and Pa | 187 |
| Wyoming | 19,004 | ------ | 132 | Mont | [6] 12,601 | 131 | 9,375 | Colo., Ind., Mo., Mont., and Utah | [6] −4,307 |
| Total United States. | 1,213,254 | 26,412 | 444,857 | ------ | 1,165,015 | 77,273 | 444,857 | ------ | −28,776 |

[1] Subject to revision.
[2] Includes South Carolina and Virginia.
[3] Includes Alabama.
[4] Includes Rhode Island.
[5] Missouri includes Utah.
[6] Includes Idaho, Nebraska, and South Dakota.

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## PRICES AND VALUE

The average value of crude petroleum at wells, which increased in both 1936 and 1937, dropped in 1938, owing to the almost general price cuts, averaging about 15 cents per barrel, in the first half of October. The estimated value for 1938 is $1.15 per barrel compared with $1.18 in 1937. From the standpoint of historical interest the 1938 average ($1.15) was just under the averages of 1878 and 1928 and just over the average of 1899. Most of the other annual averages in the 60-year interval were lower.

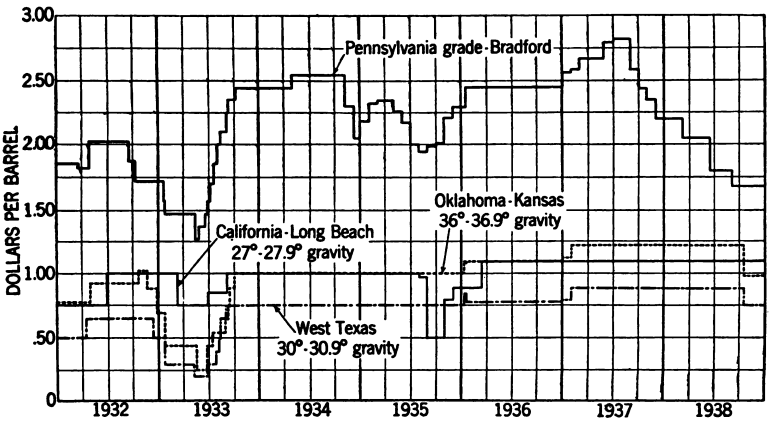


FIGURE 5.—Posted prices of selected grades of crude petroleum, 1932–38, by months.

The posted price of 36°–36.9° gravity crude in Oklahoma was $1.22 on January 1 but fell to $1.02 on October 12. This price of this grade of crude generally is used as a yardstick, although the average for the next heavier grade (34°–34.9°) in Oklahoma is generally closer to the national average.

Details of price changes for selected grades of crude petroleum are shown in the tables that follow and in figure 5.

*Average monthly prices per barrel for selected grades of crude petroleum at wells in 1938*

| Month | Pennsylvania Grade | | Illinois Basin | Oklahoma, Kansas 36°–36.9° | Panhandle, Tex. (Carson and Hutchinson Counties, 35°–35.9°) | West Texas 30°–30.9° | East Texas | Gulf-Coast Grade, 30°–30.9° | California (Long Beach, 27°–27.9°) |
|---|---|---|---|---|---|---|---|---|---|
| | Bradford | Southwest Pennsylvania | | | | | | | |
| January | $2.20 | $1.88 | $1.35 | $1.22 | $0.93 | $0.88 | $1.35 | $1.21 | $1.10 |
| February | 2.20 | 1.88 | 1.35 | 1.22 | .93 | .88 | 1.35 | 1.21 | 1.10 |
| March | 2.08 | 1.79 | 1.35 | 1.22 | .93 | .88 | 1.35 | 1.21 | 1.10 |
| April | 2.05 | 1.71 | 1.35 | 1.22 | .93 | .88 | 1.35 | 1.21 | 1.10 |
| May | 2.05 | 1.71 | 1.35 | 1.22 | .93 | .88 | 1.35 | 1.21 | 1.10 |
| June | 1.90 | 1.56 | 1.35 | 1.22 | .93 | .88 | 1.35 | 1.21 | 1.10 |
| July | 1.80 | 1.46 | 1.35 | 1.22 | .93 | .88 | 1.35 | 1.21 | 1.10 |
| August | 1.80 | 1.46 | 1.35 | 1.22 | .93 | .88 | 1.34 | 1.21 | 1.10 |
| September | 1.68 | 1.34 | 1.34 | 1.22 | .93 | .88 | 1.25 | 1.21 | 1.10 |
| October | 1.68 | 1.34 | 1.25 | 1.05 | .85 | .85 | 1.15 | 1.13 | 1.10 |
| November | 1.68 | 1.34 | 1.15 | 1.02 | .81 | .75 | 1.10 | 1.08 | 1.10 |
| December | 1.68 | 1.34 | 1.15 | 1.02 | .81 | .75 | 1.10 | 1.08 | 1.10 |
| Average for year | 1.90 | 1.56 | 1.30 | 1.18 | .90 | .85 | 1.28 | 1.18 | 1.10 |

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*Posted price per barrel of petroleum at wells in 1938, by grades, with dates of change*

| Date | Pennsylvania grade | | Corning grade in Buckeye Pipe Line Co.[2] | Western Kentucky [3] | Illinois and Princeton, Ind.,[3] | Illinois Basin [4] | Midland, Mich.[4] | Oklahoma-Kansas [5] | |
|---|---|---|---|---|---|---|---|---|---|
| | Bradford and Allegany districts [1] | In Southwest Pennsylvania pipe lines [2] | | | | | | 34°–34.9° | 36°–36.9° |
| Jan. 1 | $2.20 | $1.88 | $1.27 | $1.40 | $1.35 | $1.35 | $1.27 | $1.18 | $1.22 |
| Jan. 5 | | | | | | | 1.12 | | |
| Mar. 7 | 2.05 | 1.71 | | | | | | | |
| June 13 | 1.80 | 1.46 | | | | | | | |
| June 16 | | | 1.17 | | | | | | |
| June 22 | | | | 1.30 | | | | | |
| Sept. 1 | 1.68 | 1.34 | | | | | | | |
| Sept. 27 | | | | 1.20 | 1.25 | | | | |
| Sept. 29 | | | | | | 1.25 | | | |
| Oct. 2 | | | | | | | [6] 1.025 | | |
| Oct. 12 | | | | | | | | .98 | 1.02 |
| Oct. 13 | | | | 1.10 | 1.05 | 1.15 | | | |
| Oct. 14 | | | | | | | [6] .925 | | |
| | 1.90 | 1.56 | 1.22 | 1.30 | 1.23 | 1.30 | 1.08 | 1.14 | 1.18 |

| Date | Panhandle, Texas (Carson and Hutchinson Counties, 35°-35.9°)[5] | West Texas 30°–30.9° [5] | Hobbs, N. Mex.[5] | Darst, Tex.[5] | Southwest Texas, Duval County, 22°–22.9° [5] | Van, Texas, 34°–34.9° [4] | East Texas [5] | Gulf Coast | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Conroe, Tex., 38°–38.9° [5] | 30°–30.9° [5] | 20°–20.9° [5] |
| Jan. 1 | $0.93 | $0.88 | $0.88 | $1.09 | $1.00 | $1.02 | $1.35 | $1.40 | $1 21 | $0.96 |
| Apr. 1 | | | | | | | | | | .95 |
| Aug. 30 | | | | | | | 1.25 | | | |
| Oct. 12 | .81 | .75 | .75 | .96 | .83 | | 1.10 | [7] 1.27 | 1.08 | .82 |
| Oct. 13 | | | | | | .93 | | | | |
| | .90 | .85 | .85 | 1.06 | .96 | 1.00 | 1.28 | 1.37 | 1.18 | .92 |

| Date | Rodessa, La., 36°-36.9° [5] | Smackover, Ark.[5] | Salt Creek, Wyo., 36°–36.9° [8] | Kevin-Sunburst, Mont.[5] | California [10] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Kettleman Hills, 38°–38.9° | Long Beach, 27°–27.9° | Midway-Sunset, 19°–19.9° | Playa del Rey, 22°–22.9° | Santa Fe Springs, 33°–33.9° |
| Jan 1 | $1.17 | $0.90 | $1.22 | $1.20 | $1.39 | $1.10 | $0.74 | $0.98 | $1.20 |
| Sept. 15 | | .75 | | | | | | | |
| Oct. 5 | .97 | .73 | | | | | | | |
| Oct. 11 | | | 1.02 | | | | | | |
| | 1.12 | .85 | 1.18 | 1.20 | 1.39 | 1.10 | .74 | .98 | 1.20 |

[1] The Tide-Water Pipe Co., Ltd.
[2] The Joseph Seep Purchasing Agency.
[3] The Ohio Oil Co.
[4] The Pure Oil Co.
[5] The Texas Co.
[6] Porter and Greendale districts.
[7] Gravity basis discontinued.
[8] Standard Oil Co. of Louisiana.
[9] Stanolind Oil & Gas Co.
[10] Standard Oil Co. of California.

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*Value of crude petroleum at wells in the United States, 1936–37, by States* [1]

| State | 1936 | | 1937 | |
|---|---|---|---|---|
| | Total (thousands of dollars) | Average per barrel | Total (thousands of dollars) | Average per barrel |
| Arkansas | 8,160 | $0.78 | 11,400 | $0.97 |
| California | 215,900 | 1.01 | 242,100 | 1.02 |
| Colorado | 1,660 | 1.01 | 1,800 | 1.12 |
| Illinois | 5,390 | 1.20 | 9,970 | 1.33 |
| Indiana | 1,010 | 1.23 | 1,140 | 1.35 |
| Kansas | 65,900 | 1.13 | 88,100 | 1.25 |
| Kentucky | 7,240 | 1.29 | 7,680 | 1.40 |
| Louisiana: | | | | |
| Gulf Coast | 56,700 | 1.06 | 75,800 | 1.22 |
| Northern | 28,900 | 1.07 | 34,500 | 1.19 |
| Total—Louisiana | 85,600 | 1.06 | 110,300 | 1.21 |
| Michigan | 15,950 | 1.34 | 21,950 | 1.32 |
| Montana | 7,700 | 1.31 | 7,300 | 1.26 |
| New Mexico | 22,930 | .84 | 36,600 | .94 |
| New York | 11,380 | 2.44 | 14,140 | 2.58 |
| Ohio | 6,090 | 1.58 | 5,820 | 1.64 |
| Oklahoma | 232,100 | 1.12 | 283,500 | 1.24 |
| Pennsylvania | 41,450 | 2.43 | 49,300 | 2.57 |
| Texas: | | | | |
| Gulf Coast | 98,400 | 1.13 | 139,600 | 1.22 |
| East Texas proper | 190,900 | 1.14 | 223,700 | 1.31 |
| West Texas | 52,300 | .84 | 71,800 | .95 |
| Rest of State | 107,800 | .97 | 159,400 | 1.07 |
| Total Texas | 449,400 | 1.05 | 594,500 | 1.16 |
| West Virginia | 8,200 | 2.13 | 8,800 | 2.29 |
| Wyoming | 13,700 | .94 | 18,860 | .98 |
| Other States [2] | 60 | .95 | 80 | 1.04 |
| Total United States | 1,199,820 | 1.09 | 1,513,340 | 1.18 |

[1] Figures for 1938 not yet available.
[2] Missouri, Tennessee, and Utah.

## ROYALTIES ON INDIAN AND FEDERAL LANDS

On page 853 of Minerals Yearbook 1938 were given data up to 1937 on royalty receipts, bonuses, etc., pertaining to Indian and Federal lands. The acreage of new leases on Indian lands during the fiscal year 1938 was 99,187 compared with 155,503 (revised) in 1937. Bonuses from the sale of leases in 1938 were $239,293, royalty from production of oil and gas totaled $5,048,280, and advance royalty and annual rentals amounted to $502,664.

The production of crude petroleum on Government lands in the calendar year 1938 totaled 43,515,000 barrels, of which 5,369,000 barrels valued at $5,869,000 was royalty.

## REFINED PRODUCTS

Despite the general set-back in business conditions in 1938, petroleum refining was not affected nearly as much statistically as were many other industries. Domestic motor-fuel demand made a new record of 521,657,000 barrels, exceeding the 1937 demand by one-half of 1 percent, while the export demand increased 31 percent, making an increase of 2.5 percent in total motor-fuel demand.

Crude runs to stills dropped from 1,183,440,000 barrels in 1937 to 1,165,015,000 in 1938. Domestic demand for gas oil and distillate fuel oils was about the same as for 1937, and the demand for residual

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fuel oils declined from 325,514,000 barrels to 292,650,000. The demand for kerosene and asphalt increased slightly, but the demand for lubricants, wax, coke, and road oil was less than for 1937.

*Comparative analyses of statistics for the major refined products, 1934–38*

[Thousands of barrels, except as otherwise indicated]

| | 1934 | 1935 | 1936 | 1937 | 1938[1] |
|---|---|---|---|---|---|
| **Motor fuel:** | | | | | |
| Production | 423,801 | 468,021 | 516,266 | 571,727 | 567,905 |
| Imports | 1 | | 78 | 144 | 79 |
| Exports | 24,686 | 30,613 | 28,646 | 38,306 | 50,198 |
| Stocks, end of period | 51,747 | 54,345 | 60,437 | 74,650 | 70,779 |
| Domestic demand | 407,106 | 434,810 | 481,606 | 519,352 | 521,657 |
| **Kerosene:** | | | | | |
| Production | 53,855 | 55,813 | 56,082 | 65,308 | 64,580 |
| Exports | 9,781 | 6,651 | 6,936 | 8,886 | 7,513 |
| Stocks, end of period | 6,398 | 7,915 | 5,633 | 7,083 | 7,799 |
| Domestic demand | 44,234 | 47,645 | 51,428 | 54,972 | 56,351 |
| **Gas oil and distillate fuel oils:** | | | | | |
| Production | 94,972 | 100,235 | 125,906 | 146,706 | 151,774 |
| Imports | [2] | 15 | 182 | 17 | |
| Exports | [2] | 16,249 | 20,448 | 30,129 | 29,903 |
| Stocks, end of period | 21,957 | 19,930 | 22,813 | 22,566 | 27,873 |
| Domestic demand | [2] | 86,028 | 102,757 | 116,841 | 116,564 |
| **Residual fuel oils:** | | | | | |
| Production | 240,381 | 259,826 | 287,968 | 312,064 | 294,972 |
| Transfers [3] | 8,382 | 13,067 | 15,732 | 17,423 | 10,660 |
| Imports | [2] | 16,115 | 18,801 | 22,114 | 20,985 |
| Exports | [2] | 12,699 | 14,435 | 15,304 | 17,728 |
| Stocks, end of period | [4] 88,440 | [4] 84,054 | [4] 84,236 | { [4] 95,019 / [5] 81,507 } | 97,746 |
| Domestic demand | [2] | 280,695 | 307,884 | 325,514 | 292,650 |
| **Lubricants:** | | | | | |
| Production | 26,373 | 27,853 | 30,927 | 35,321 | 30,826 |
| Imports | 2 | 1 | 4 | 7 | 7 |
| Exports | 7,660 | 8,499 | 8,691 | 10,975 | 9,402 |
| Stocks, end of period | 7,331 | 7,025 | { 6,942 / [5] 6,482 } | 7,512 | 7,695 |
| Domestic demand | 18,484 | 19,661 | 22,323 | 23,323 | 21,248 |
| **Wax (thousands of pounds):** | | | | | |
| Production | 468,720 | 450,240 | 472,920 | 521,640 | 435,400 |
| Imports | 37,292 | 19,557 | 16,669 | 36,929 | 28,927 |
| Exports | 198,958 | 229,905 | 187,342 | 231,723 | 201,919 |
| Stocks, end of period | 136,136 | 114,675 | 115,434 | 144,992 | 129,340 |
| Domestic demand | 240,035 | 261,353 | 301,488 | 297,288 | 278,060 |
| **Coke (thousands of short tons):** | | | | | |
| Production | 1,300.0 | 1,458.0 | 1,378.2 | 1,306.6 | 1,602.2 |
| Exports | 114.3 | 133.5 | 124.6 | 164.3 | 155.6 |
| Stocks, end of period | 405.1 | 388.9 | 389.4 | 378.6 | 707.5 |
| Domestic demand | 1,508.1 | 1,340.7 | 1,253.1 | 1,153.1 | 1,117.7 |
| **Asphalt (thousands of short tons):** | | | | | |
| Production | 2,840.5 | 3,115.1 | 3,868.8 | 4,182.0 | 4,392.4 |
| Imports | 15.6 | 54.0 | 21.6 | 34.1 | 33.2 |
| Exports | 239.9 | 232.8 | 211.4 | 45.5 | 50.2 |
| Stocks, end of period | 339.2 | 429.7 | 364.2 | { 557.4 / [5] 566.1 } | 480.9 |
| Domestic demand | 2,536.5 | 2,845.8 | 3,744.5 | 3,977.4 | 4,460.6 |
| **Road oil:** | | | | | |
| Production | 6,210 | 6,030 | 7,398 | 8,087 | 7,788 |
| Stocks, end of period | 664 | 732 | 851 | { 984 / [5] 667 } | 680 |
| Domestic demand | 6,378 | 5,962 | 7,279 | 7,954 | 7,775 |
| **Other finished products:** | | | | | |
| Production | 1,872 | 1,888 | 2,148 | 2,382 | 1,921 |
| Imports | 316 | 150 | | | |
| Exports | 47 | 76 | 71 | 101 | 112 |
| Stocks, end of period | 231 | 220 | 198 | 230 | 263 |
| Domestic demand | 2,126 | 1,973 | 2,099 | 2,249 | 1,776 |

[1] Subject to revision.
[2] Figures not available.
[3] Net transfers from crude oil to fuel oil in California.
[4] California heavy crude included.
[5] For comparison with succeeding year.

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The yield of gasoline reversed its downward trend to increase from 43.9 percent in 1937 to 44.3 in 1938. The yield of gas oil and distillate fuel oils also increased from 12.4 to 13.0, percent while that of the residual fuel oils decreased from 26.4 to 25.3 percent. (See fig. 6.)

Natural-gasoline production increased from about 49 million barrels in 1937 to about 50 million in 1938, but benzol production declined from 2,790,000 barrels in 1937 to 1,699,000 in 1938.

The total refinery output of gasoline in 1938 was about 556 million barrels, comprising about 245 million barrels of straight-run gasoline, 271 million barrels of cracked gasoline, and 40 million barrels of natural gasoline.

*Runs to stills and production at refineries of the various refined products, 1934–38*

[Thousands of barrels, except as otherwise indicated]

| | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| Input: | | | | | |
| Crude petroleum: | | | | | |
| Domestic | 860,776 | 933,659 | 1,034,637 | 1,157,444 | 1,138,828 |
| Foreign | 34,860 | 32,131 | 33,933 | 25,996 | 26,187 |
| Total crude petroleum | 895,636 | 965,790 | 1,068,570 | 1,183,440 | 1,165,015 |
| Natural gasoline [2] | 28,162 | 31,025 | 33,817 | 39,381 | 39,961 |
| Total input | 923,798 | 996,815 | 1,102,387 | 1,222,821 | 1,204,976 |
| Output: | | | | | |
| Gasoline | 416,932 | 457,842 | 504,811 | 559,141 | 555,850 |
| Kerosene | 53,855 | 55,813 | 56,082 | 65,308 | 64,580 |
| Gas oil and distillate fuel oils | 94,972 | 100,235 | 125,906 | 146,706 | 151,774 |
| Residual fuel oils | 240,381 | 259,826 | 287,968 | 312,064 | 294,972 |
| Lubricants | 26,373 | 27,853 | 30,927 | 35,321 | 30,826 |
| Wax | 1,674 | 1,608 | 1,689 | 1,863 | 1,555 |
| Coke | 6,500 | 7,290 | 6,891 | 6,533 | 8,011 |
| Asphalt | 15,623 | 17,133 | 21,278 | 23,001 | 24,159 |
| Still gas | 44,391 | 51,184 | 57,046 | 64,218 | 62,410 |
| Wax—thousands of pounds | 468,720 | 450,240 | 472,920 | 521,640 | 435,400 |
| Coke—thousands of short tons | 1,300.0 | 1,458.0 | 1,378.2 | 1,306.6 | 1,602.2 |
| Asphalt—do | 2,840.5 | 3,115.1 | 3,868.8 | 4,182.0 | 4,392.4 |
| Still gas—millions of cubic feet | 169,479 | 197,220 | 226,466 | 241,981 | 236,943 |
| Road oil | 6,210 | 6,030 | 7,398 | 8,087 | 7,788 |
| Other finished products | 1,872 | 1,888 | 2,148 | 2,382 | 1,921 |
| Crude gasoline (net) | [3] 3,007 | 1,032 | 486 | [3] 128 | [3] 1,616 |
| Other unfinished oils (net) | 1,949 | [3] 2,412 | [3] 8,962 | [3] 7,931 | [3] 4,450 |
| Shortage | 16,073 | 11,493 | 8,719 | 6,256 | 7,196 |
| Total output | 923,798 | 996,815 | 1,102,387 | 1,222,821 | 1,204,976 |

[1] Subject to revision.
[2] Includes natural gasoline run through pipe lines in California.
[3] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

These statistics, however, do not give a true picture of the distress brought to the industry by the recession. Domestic motor-fuel demand was halted in its upward sweep of early 1937, in the first 4 months of which it was more than 11 percent higher than for the same period in 1936. In contrast, the increase in the demand for the first half of 1938 was less than one-half of 1 percent over the demand for the same period of 1937. The inability of the industry to adjust its operations to the sudden change from the rapid upward trend to the retarded demand caused a large accumulation of stocks. Finished and unfinished gasoline inventories reached a peak of more than 92 million barrels, or 57 day's supply on March 31, 1938, compared with 82 million barrels or 51 day's supply on the same date in 1937. Stocks

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of residual fuel oil increased from 78 million to 87 million barrels and distillate fuel oil stocks from 17 million to 19 million barrels during this same period.

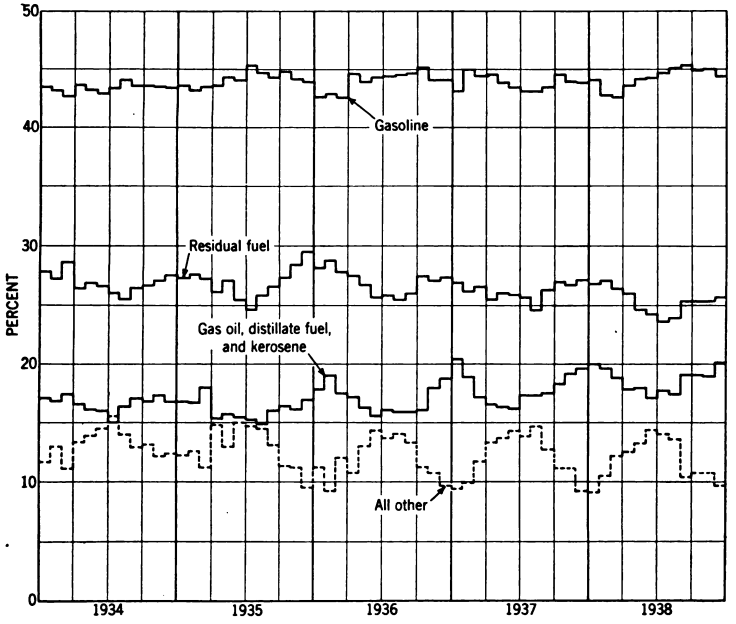


FIGURE 6.—Yields of principal petroleum products from crude oil run to stills, 1934–38, by months.

Prices dropped sharply. The refinery price for Oklahoma gasoline fell from a high of 6.19 cents per gallon in May 1937 to 4.90 cents in May 1938. (See fig. 7.) This represented a loss of more than 20 per-

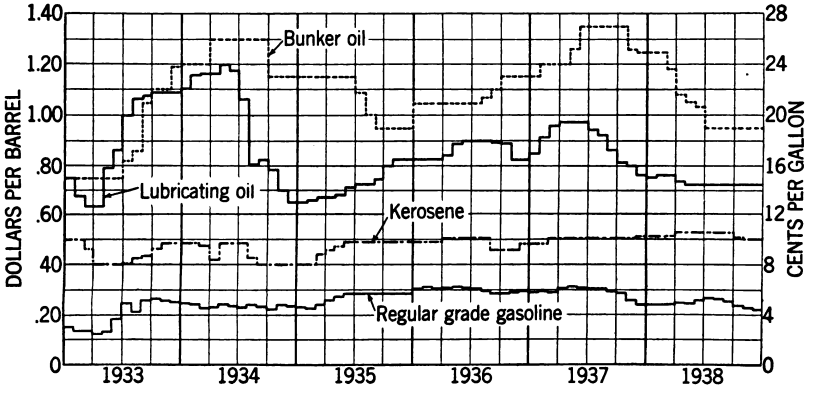


FIGURE 7.—Prices of refined petroleum products, 1933–38, by months.

cent for the year, whereas the Bureau of Labor Statistics index of wholesale prices of all commodities decreased only 11 percent during this period. Heavy fuel-oil prices dropped nearly 10 cents per barrel between the summer of 1937 and August 1938, while the prices of most lubricating oils declined.

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*Runs to stills and production at refineries in the United States of the various refined products, 1937–38, by months*

[Thousands of barrels, except as otherwise indicated]

| | January | February | March | April | May | June | July | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| Input: | | | | | | | | | | | | | |
| Crude petroleum [1] | 94,179 | 84,984 | 94,400 | 93,573 | 100,452 | 99,323 | 104,783 | 105,251 | 103,494 | 105,023 | 99,615 | 98,363 | 1,183,440 |
| Natural gasoline [2] | 3,003 | 2,516 | 2,570 | 2,695 | 2,642 | 2,571 | 2,981 | 3,557 | 4,490 | 4,377 | 4,088 | 3,891 | 39,381 |
| Total input | 97,182 | 87,500 | 96,970 | 96,268 | 103,094 | 101,894 | 107,764 | 108,808 | 107,984 | 109,400 | 103,703 | 102,254 | 1,222,821 |
| Fresh cracking stocks charged to stills: | | | | | | | | | | | | | |
| Crude oil | 8,591 | 9,213 | 10,269 | 10,387 | 10,563 | 10,601 | 11,876 | 12,204 | 11,868 | 10,871 | 11,598 | 12,552 | 130,593 |
| Other oils | 44,513 | 39,398 | 44,014 | 42,264 | 45,982 | 44,249 | 46,154 | 46,603 | 45,507 | 47,263 | 44,064 | 44,045 | 534,056 |
| Output: | | | | | | | | | | | | | |
| Gasoline | 43,630 | 40,782 | 44,621 | 44,475 | 46,769 | 45,748 | 48,271 | 49,002 | 49,683 | 51,223 | 47,873 | 47,064 | 559,141 |
| Kerosene | 5,923 | 4,866 | 5,187 | 4,907 | 5,343 | 5,087 | 5,482 | 5,726 | 5,371 | 5,731 | 5,876 | 5,809 | 65,308 |
| Gas oil and distillate fuel oils | 13,319 | 11,206 | 11,005 | 10,674 | 11,158 | 11,088 | 12,654 | 12,558 | 12,681 | 13,585 | 13,215 | 13,563 | 146,706 |
| Residual fuel oil | 25,623 | 22,302 | 25,191 | 24,100 | 26,587 | 26,033 | 26,958 | 26,026 | 27,094 | 28,425 | 26,687 | 27,038 | 312,064 |
| Lubricants | 2,649 | 2,728 | 2,873 | 3,048 | 3,141 | 2,978 | 2,980 | 2,900 | 2,920 | 3,215 | 2,953 | 2,936 | 35,321 |
| Wax | 149 | 149 | 149 | 156 | 170 | 147 | 156 | 150 | 150 | 158 | 175 | 154 | 1,863 |
| Coke | 511 | 458 | 536 | 509 | 548 | 498 | 548 | 565 | 567 | 635 | 556 | 602 | 6,533 |
| Asphalt | 1,200 | 978 | 1,509 | 1,751 | 2,189 | 2,454 | 2,570 | 2,780 | 2,575 | 2,159 | 1,734 | 1,102 | 23,001 |
| Still gas | 4,864 | 4,614 | 5,253 | 5,293 | 5,789 | 5,576 | 5,778 | 5,869 | 5,574 | 5,453 | 5,081 | 5,074 | 64,218 |
| Wax, thousands of pounds | 41,720 | 41,720 | 41,720 | 43,680 | 47,600 | 41,160 | 43,680 | 42,000 | 42,000 | 44,240 | 49,000 | 43,120 | 521,640 |
| Coke, thousands of short tons | 102.2 | 91.6 | 107.2 | 101.8 | 109.6 | 99.6 | 109.6 | 113.0 | 113.4 | 127.0 | 111.2 | 120.4 | 1,306.6 |
| Asphalt, do | 218.2 | 177.8 | 274.4 | 318.5 | 398.0 | 446.2 | 467.2 | 505.4 | 468.1 | 392.6 | 315.3 | 200.3 | 4,182.0 |
| Still gas, millions of cubic feet | 18,716 | 17,544 | 19,941 | 19,917 | 21,585 | 20,709 | 21,301 | 21,820 | 20,697 | 20,581 | 19,538 | 19,632 | 241,981 |
| Road oil | 189 | 217 | 217 | 408 | 799 | 1,413 | 1,474 | 1,529 | 791 | 517 | 298 | 235 | 8,087 |
| Other finished products | 175 | 185 | 247 | 192 | 196 | 199 | 222 | 188 | 227 | 228 | 136 | 187 | 2,382 |
| Crude gasoline (net) | 311 | [3] 163 | 520 | [3] 232 | 160 | 36 | [3] 55 | [3] 46 | [3] 160 | [3] 536 | [3] 71 | 108 | [3] 128 |
| Other unfinished oils (net) | [3] 1,870 | [3] 982 | [3] 781 | 603 | [3] 66 | [3] 96 | [3] 161 | 827 | [3] 241 | [3] 2,043 | [3] 1,265 | [3] 1,856 | [3] 7,931 |
| Shortage | 509 | 160 | 443 | 394 | 311 | 733 | 887 | 734 | 752 | 650 | 455 | 238 | 6,256 |
| Total output | 97,182 | 87,500 | 96,970 | 96,268 | 103,094 | 101,894 | 107,764 | 108,808 | 107,984 | 109,400 | 103,703 | 102,254 | 1,222,821 |

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| 1938 [4] | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Input:** | | | | | | | | | | | | | |
| Crude petroleum [1] | 97,900 | 88,179 | 95,885 | 95,675 | 99,238 | 93,880 | 99,856 | 101,352 | 96,990 | 100,787 | 97,309 | 97,964 | 1,165,015 |
| Natural gasoline [2] | 3,557 | 2,728 | 3,233 | 2,856 | 2,799 | 2,635 | 2,935 | 2,950 | 3,329 | 4,432 | 4,222 | 4,285 | 39,961 |
| Total input | 101,457 | 90,907 | 99,118 | 98,531 | 102,037 | 96,515 | 102,791 | 104,302 | 100,319 | 105,219 | 101,531 | 102,249 | 1,204,976 |
| Fresh cracking stocks charged to stills: | | | | | | | | | | | | | |
| Crude oil | 12,645 | 11,632 | 12,312 | 11,128 | 12,523 | 10,916 | 12,075 | 12,582 | 11,392 | 13,377 | 12,256 | 12,919 | 145,757 |
| Other oils | 43,944 | 38,824 | 42,576 | 43,642 | 45,880 | 45,571 | 48,009 | 48,660 | 46,860 | 46,792 | 44,674 | 44,961 | 540,393 |
| **Output:** | | | | | | | | | | | | | |
| Gasoline | 46,755 | 40,469 | 44,116 | 44,582 | 46,645 | 44,247 | 47,607 | 48,662 | 47,312 | 49,677 | 47,998 | 47,780 | 555,850 |
| Kerosene | 5,638 | 5,167 | 5,798 | 5,445 | 5,649 | 5,235 | 4,889 | 4,933 | 5,348 | 5,320 | 5,419 | 5,739 | 64,580 |
| Gas oil and distillate fuel oils | 13,876 | 12,144 | 12,294 | 11,577 | 12,160 | 10,784 | 12,688 | 12,691 | 13,074 | 13,820 | 12,793 | 13,873 | 151,774 |
| Residual fuel oil | 26,204 | 23,866 | 25,328 | 24,833 | 24,392 | 22,761 | 23,547 | 24,232 | 24,552 | 25,487 | 24,573 | 25,197 | 294,972 |
| Lubricants | 2,785 | 2,468 | 2,697 | 2,530 | 2,595 | 2,378 | 2,631 | 2,576 | 2,615 | 2,632 | 2,535 | 2,384 | 30,826 |
| Wax | 149 | 124 | 142 | 113 | 127 | 135 | 108 | 114 | 130 | 150 | 134 | 129 | 1,555 |
| Coke | 631 | 610 | 570 | 635 | 689 | 685 | 688 | 742 | 554 | 734 | 764 | 709 | 8,011 |
| Asphalt | 1,187 | 1,054 | 1,534 | 1,837 | 2,475 | 2,451 | 2,617 | 2,829 | 2,510 | 2,557 | 1,775 | 1,333 | 24,159 |
| Still gas | 4,937 | 4,428 | 4,901 | 5,073 | 5,542 | 5,387 | 5,730 | 5,753 | 5,287 | 5,356 | 5,083 | 4,933 | 62,410 |
| Wax—thousands of pounds | 41,720 | 34,720 | 39,760 | 31,640 | 35,560 | 37,800 | 30,240 | 31,920 | 36,400 | 42,000 | 37,520 | 36,120 | 435,400 |
| Coke—thousands of short tons | 126.2 | 122.0 | 114.0 | 127.0 | 137.8 | 137.0 | 137.6 | 148.4 | 110.8 | 146.8 | 152.8 | 141.8 | 1,602.2 |
| Asphalt—do | 215.8 | 191.6 | 278.9 | 334.0 | 450.0 | 445.6 | 475.8 | 514.4 | 456.3 | 464.9 | 322.7 | 242.4 | 4,392.4 |
| Still gas—millions of cubic feet | 18,968 | 16,950 | 18,476 | 19,128 | 20,801 | 20,197 | 21,277 | 21,780 | 20,052 | 20,629 | 19,727 | 18,958 | 236,943 |
| Road oil | 157 | 158 | 265 | 435 | 660 | 1,286 | 1,418 | 1,477 | 964 | 572 | 202 | 194 | 7,788 |
| Other finished products | 150 | 157 | 201 | 167 | 187 | 160 | 160 | 142 | 137 | 152 | 143 | 165 | 1,921 |
| Crude gasoline (net) | [3] 434 | 503 | 23 | 90 | [3] 215 | [3] 354 | [3] 352 | [3] 245 | [3] 440 | [3] 188 | [3] 283 | 279 | [3] 1,616 |
| Other unfinished oils (net) | [3] 1,212 | [3] 615 | 615 | 414 | 442 | 728 | 372 | [3] 271 | [3] 2,236 | [3] 1,785 | [3] 28 | [3] 874 | [3] 4,450 |
| Shortage | 634 | 374 | 634 | 800 | 689 | 632 | 688 | 667 | 512 | 735 | 423 | 408 | 7,196 |
| Total output | 101,457 | 90,907 | 99,118 | 98,531 | 102,037 | 96,515 | 102,791 | 104,302 | 100,319 | 105,219 | 101,531 | 102,249 | 1,204,976 |

[1] Details by districts and months in section on "Consumption and distribution of crude petroleum."
[2] Includes 1,374,000 barrels run through pipe lines in California in 1937 and 1,349,000 barrels in 1938.
[3] Negative quantity; represents net excess rerun over production.
[4] Subject to revision.

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*Runs to stills and production at refineries in the United States of the various refined products, 1937–38, by districts*

[Thousands of barrels, except as otherwise indicated]

| | East Coast | Appalachian | Indiana, Illinois, Kentucky, etc. | Oklahoma, Kansas, and Missouri | Texas Inland | Texas Gulf Coast | Louisiana Gulf Coast | Arkansas and Louisiana Inland | Rocky Mountain | California | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | |
| Input: | | | | | | | | | | | |
| Crude petroleum [1] | 198,080 | 40,286 | 164,243 | 121,238 | 75,415 | 282,014 | 50,742 | 24,912 | 23,365 | 203,145 | 1,183,440 |
| Natural gasoline [2] | 1,540 | 362 | 4,077 | 5,895 | 5,816 | 6,730 | 835 | 731 | 826 | 12,569 | 39,381 |
| Total input | 199,620 | 40,648 | 168,320 | 127,133 | 81,231 | 288,744 | 51,577 | 25,643 | 24,191 | 215,714 | 1,222,821 |
| Fresh cracking stocks charged to stills: | | | | | | | | | | | |
| Crude oil | 31,778 | 378 | 12,886 | 860 | 2,132 | 67,657 | 10,456 | 2,706 | 1,740 | ---------- | 130,593 |
| Other oils | 89,614 | 15,655 | 103,451 | 62,655 | 33,574 | 112,817 | 23,306 | 7,504 | 9,761 | 75,719 | 534,056 |
| Output: | | | | | | | | | | | |
| Gasoline | 81,096 | 19,939 | 95,409 | 69,576 | 44,391 | 125,888 | 18,241 | 11,170 | 13,464 | 79,967 | 559,141 |
| Kerosene | 11,024 | 3,220 | 6,238 | 7,396 | 3,515 | 20,351 | 5,927 | 1,787 | 796 | 5,054 | 65,308 |
| Gas oil and distillate fuel oils | 30,020 | 2,756 | 17,033 | 11,434 | 5,423 | 39,385 | 7,800 | 2,428 | 1,462 | 28,965 | 146,706 |
| Residual fuel oils | 55,274 | 4,315 | 24,953 | 21,819 | 20,914 | 73,223 | 13,212 | 6,215 | 4,439 | 87,700 | 312,064 |
| Lubricants | 9,360 | 6,083 | 3,457 | 3,659 | 229 | 7,929 | 1,246 | 467 | 305 | 2,586 | 35,321 |
| Wax | 892 | 312 | 154 | 120 | 12 | 188 | 100 | 6 | 79 | ---------- | 1,863 |
| Coke | 52 | 122 | 3,634 | 1,181 | 531 | 564 | 83 | 10 | 354 | 2 | 6,533 |
| Asphalt | 9,155 | 563 | 3,920 | 1,475 | 612 | 1,246 | 1,254 | 896 | 697 | 3,183 | 23,001 |
| Still gas | 10,339 | 2,301 | 12,377 | 6,968 | 3,537 | 17,893 | 1,993 | 899 | 1,344 | 6,567 | 64,218 |
| Wax ----------thousands of pounds | 249,760 | 87,360 | 43,120 | 33,600 | 3,360 | 52,640 | 28,000 | 1,680 | 22,120 | ---------- | 521,640 |
| Coke----------thousands of short tons | 10.4 | 24.4 | 726.8 | 236.2 | 106.2 | 112.8 | 16.6 | 2.0 | 70.8 | .4 | 1,306.6 |
| Asphalt----------do | 1,664.5 | 102.4 | 712.7 | 268.1 | 111.2 | 226.6 | 228.0 | 162.9 | 126.8 | 578.8 | 4,182.0 |
| Still gas----------millions of cubic feet | 31,835 | 8,836 | 46,710 | 28,721 | 15,990 | 70,240 | 7,413 | 3,894 | 5,106 | 25,236 | 241,981 |
| Road oil | 903 | 49 | 1,854 | 688 | 3 | 293 | 126 | 371 | 1,111 | 2,689 | 8,087 |
| Other finished products | 768 | 248 | 398 | 152 | 168 | 296 | 40 | 10 | 117 | 185 | 2,382 |
| Crude gasoline (net) | [3] 369 | [3] 42 | [3] 1,274 | 1,292 | 122 | 255 | [3] 230 | 6 | 3 | 109 | [3] 128 |
| Other unfinished oils (net) | [3] 7,889 | [3] 46 | 865 | [3] 412 | 289 | [3] 577 | 1,000 | 624 | [3] 473 | [3] 1,312 | [3] 7,931 |
| Shortage | [4] 1,005 | 828 | [4] 698 | 1,785 | 1,485 | 1,810 | 785 | 754 | 493 | 19 | 6,256 |
| Total output | 199,620 | 40,648 | 168,320 | 127,133 | 81,231 | 288,744 | 51,577 | 25,643 | 24,191 | 215,714 | 1,222,821 |

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| 1938 [5] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Input: | | | | | | | | | | | |
| Crude petroleum [1] | 180,606 | 39,180 | 163,140 | 111,143 | 66,923 | 307,906 | 46,903 | 24,089 | 24,791 | 200,334 | 1,165,015 |
| Natural gasoline [2] | 1,198 | 269 | 4,488 | 5,772 | 6,625 | 6,063 | 382 | 737 | 803 | 13,624 | 39,961 |
| Total input | 181,804 | 39,449 | 167,628 | 116,915 | 73,548 | 313,969 | 47,285 | 24,826 | 25,594 | 213,958 | 1,204,976 |
| Fresh cracking stocks charged to stills: | | | | | | | | | | | |
| Crude oil | 22,843 | 5,268 | 19,188 | 2,814 | 2,169 | 76,446 | 7,975 | 1,563 | 1,960 | 5,531 | 145,757 |
| Other oils | 87,540 | 13,629 | 97,667 | 58,468 | 32,793 | 117,494 | 22,199 | 6,669 | 9,566 | 94,368 | 540,393 |
| Output: | | | | | | | | | | | |
| Gasoline | 73,547 | 19,380 | 95,511 | 65,719 | 42,764 | 139,663 | 17,044 | 10,775 | 13,919 | 77,528 | 555,850 |
| Kerosene | 9,208 | 2,769 | 7,096 | 6,960 | 2,985 | 22,357 | 6,037 | 2,139 | 810 | 4,219 | 64,580 |
| Gas oil and distillate fuel oils | 28,559 | 2,446 | 17,397 | 11,163 | 4,217 | 47,529 | 7,450 | 2,341 | 1,689 | 28,983 | 151,774 |
| Residual fuel oils | 50,722 | 4,725 | 23,319 | 19,101 | 15,871 | 73,774 | 10,806 | 5,697 | 4,916 | 86,041 | 294,972 |
| Lubricants | 7,613 | 5,763 | 2,609 | 2,962 | 213 | 7,628 | 1,097 | 452 | 205 | 2,284 | 30,826 |
| Wax | 702 | 296 | 113 | 110 | 7 | 215 | 70 | 1 | 41 | ---------- | 1,555 |
| Coke | 19 | 100 | 4,889 | 1,068 | 507 | 705 | 303 | 6 | 329 | 85 | 8,011 |
| Asphalt | 9,534 | 653 | 3,703 | 1,599 | 1,499 | 1,193 | 1,355 | 941 | 538 | 3,144 | 24,159 |
| Still gas | 9,188 | 2,187 | 12,244 | 5,775 | 2,999 | 19,039 | 2,290 | 552 | 1,227 | 6,909 | 62,410 |
| Wax—thousands of pounds | 196,560 | 82,880 | 31,640 | 30,800 | 1,960 | 60,200 | 19,600 | 280 | 11,480 | ---------- | 435,400 |
| Coke—thousands of short tons | 3.8 | 20.0 | 977.8 | 213.6 | 101.4 | 141.0 | 60.6 | 1.2 | 65.8 | 17.0 | 1,602.2 |
| Asphalt—do | 1,733.4 | 118.7 | 673.3 | 290.7 | 272.4 | 217.1 | 246.5 | 170.9 | 97.8 | 571.6 | 4,392.4 |
| Still gas—millions of cubic feet | 27,662 | 8,232 | 46,797 | 21,935 | 13,881 | 76,150 | 9,176 | 2,505 | 4,973 | 25,632 | 236,943 |
| Road oil | 331 | 140 | 1,750 | 830 | 1 | 235 | 15 | 417 | 1,238 | 2,831 | 7,788 |
| Other finished products | 790 | 170 | 295 | 120 | 58 | 104 | 47 | 1 | 97 | 239 | 1,921 |
| Crude gasoline (net) | [3] 94 | [3] 8 | [3] 952 | 386 | [3] 83 | [3] 590 | [3] 372 | [3] 6 | 2 | 101 | [3] 1,616 |
| Other unfinished oils (net) | [3] 6,897 | [3] 45 | 258 | [3] 986 | 853 | 543 | 462 | 687 | 78 | 597 | [3] 4,450 |
| Shortage | [4] 1,418 | 873 | [4] 604 | 2,108 | 1,657 | 1,574 | 681 | 823 | 505 | 997 | 7,196 |
| Total output | 181,804 | 39,449 | 167,628 | 116,915 | 73,548 | 313,969 | 47,285 | 24,826 | 25,594 | 213,958 | 1,204,976 |

[1] Details by districts and months in section on "Consumption and distribution of crude petroleum."
[2] Includes 1,374,000 barrels run through pipe lines in California in 1937 and 1,349,000 barrels in 1938.
[3] Negative quantity; represents net excess rerun over production.
[4] Negative quantity.
[5] Subject to revision.

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*Stocks of refined products in the United States, 1937–38, by months*

[Thousands of barrels, except as otherwise indicated]

| | Jan. 1[1] | Jan. 31 | Feb. 28 | Mar. 31 | Apr. 30 | May 31 | June 30 | July 31 | Aug. 31 | Sept. 30 | Oct. 31 | Nov. 30 | Dec. 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| Gasoline | 56,382 | 64,293 | 71,453 | 74,171 | 73,419 | 72,396 | 67,839 | 62,956 | 59,413 | 58,037 | 61,141 | 63,728 | 69,892 |
| Kerosene | 5,633 | 5,622 | 5,443 | 5,396 | 5,047 | 5,576 | 6,781 | 7,553 | 8,637 | 8,839 | 8,877 | 8,357 | 7,083 |
| Gas oil and distillate fuel oil | 22,813 | 19,088 | 18,211 | 16,724 | 16,889 | 18,451 | 20,657 | 23,637 | 25,952 | 27,020 | 28,101 | 26,852 | 22,566 |
| Residual fuel oils | 84,236 | 83,406 | 80,571 | 78,435 | 77,318 | 79,158 | 81,224 | 84,154 | 86,420 | 89,007 | 92,182 | 93,225 | 95,019 |
| Lubricants | 6,482 | 6,788 | 7,115 | 6,771 | 6,556 | 6,478 | 6,447 | 6,566 | 6,426 | 6,542 | 6,789 | 6,907 | 7,512 |
| Wax | 412 | 399 | 403 | 386 | 368 | 379 | 377 | 390 | 415 | 441 | 461 | 499 | 518 |
| Coke | 1,947 | 1,921 | 1,898 | 2,016 | 2,058 | 1,996 | 1,952 | 1,901 | 1,878 | 1,802 | 1,646 | 1,831 | 1,893 |
| Asphalt | 2,003 | 2,441 | 2,445 | 2,730 | 2,905 | 3,010 | 2,870 | 2,752 | 2,910 | 2,560 | 2,521 | 2,807 | 3,066 |
| Wax—thousands of pounds | 115,434 | 111,790 | 112,862 | 108,103 | 103,175 | 106,089 | 105,676 | 109,318 | 116,231 | 123,563 | 129,095 | 139,887 | 144,992 |
| Coke—thousands of short tons | 389.4 | 384.1 | 379.7 | 403.3 | 411.7 | 399.2 | 390.5 | 380.1 | 375.5 | 360.4 | 329.2 | 366.2 | 378.6 |
| Asphalt—do | 364.2 | 443.9 | 444.6 | 496.5 | 528.3 | 547.3 | 521.9 | 500.5 | 529.1 | 465.4 | 458.3 | 510.4 | 557.4 |
| Road oil | 851 | 814 | 797 | 853 | 1,030 | 1,139 | 1,207 | 1,175 | 1,156 | 973 | 961 | 945 | 984 |
| Other finished products | 198 | 210 | 201 | 195 | 204 | 197 | 185 | 197 | 199 | 200 | 219 | 206 | 230 |
| Crude gasoline | 6,812 | 7,123 | 6,960 | 7,480 | 7,248 | 7,408 | 7,444 | 7,389 | 7,343 | 7,343 | 6,896 | 6,900 | 7,098 |
| Other unfinished oils | 38,826 | 37,412 | 36,865 | 36,746 | 37,787 | 38,555 | 39,017 | 39,570 | 41,074 | 41,229 | 39,796 | 38,853 | 37,552 |
| | 226,595 | 229,517 | 232,362 | 231,903 | 230,829 | 234,743 | 236,000 | 238,240 | 241,823 | 243,993 | 249,590 | 251,110 | 253,413 |
| 1938[1] | | | | | | | | | | | | | |
| Gasoline | 69,892 | 79,114 | 85,018 | 85,035 | 82,684 | 80,987 | 73,725 | 70,224 | 64,599 | 63,163 | 63,542 | 64,083 | 65,949 |
| Kerosene | 7,083 | 6,523 | 5,986 | 6,093 | 6,394 | 7,627 | 9,202 | 10,112 | 10,149 | 10,497 | 9,949 | 9,676 | 7,799 |
| Gas oil and distillate fuel oil | 22,566 | 21,543 | 19,885 | 18,882 | 19,972 | 22,385 | 24,699 | 26,620 | 28,841 | 30,860 | 33,017 | 32,069 | 27,873 |
| Residual fuel oils | 81,507 | 83,902 | 85,753 | 86,920 | 90,893 | 93,753 | 95,690 | 99,363 | 100,431 | 102,831 | 103,423 | 101,569 | 97,746 |
| Lubricants | 7,512 | 8,006 | 8,363 | 8,210 | 8,290 | 8,255 | 8,114 | 8,194 | 7,969 | 7,605 | 7,718 | 7,817 | 7,695 |
| Wax | 518 | 520 | 532 | 537 | 517 | 503 | 494 | 485 | 479 | 461 | 461 | 471 | 462 |
| Coke | 1,893 | 1,948 | 2,094 | 2,342 | 2,611 | 2,808 | 2,872 | 3,049 | 3,253 | 3,113 | 3,269 | 3,392 | 3,537 |
| Asphalt | 3,114 | 3,268 | 3,412 | 3,482 | 3,650 | 3,909 | 3,681 | 3,483 | 3,115 | 2,591 | 2,432 | 2,462 | 2,645 |
| Wax—thousands of pounds | 144,992 | 145,629 | 148,823 | 150,465 | 144,626 | 140,826 | 138,260 | 135,911 | 134,103 | 129,018 | 128,926 | 131,772 | 129,340 |
| Coke—thousands of short tons | 378.6 | 389.5 | 418.8 | 468.5 | 522.3 | 561.6 | 574.3 | 609.8 | 650.6 | 622.6 | 653.8 | 678.4 | 707.5 |
| Asphalt—do | 566.1 | 594.2 | 620.4 | 633.2 | 663.7 | 710.7 | 669.3 | 633.2 | 566.4 | 471.1 | 442.2 | 447.6 | 480.9 |
| Road oil | 667 | 673 | 663 | 797 | 1,024 | 1,091 | 1,103 | 1,052 | 948 | 814 | 680 | 660 | 680 |
| Other finished products | 230 | 230 | 250 | 299 | 296 | 326 | 319 | 295 | 274 | 265 | 265 | 260 | 263 |
| Crude gasoline | 7,098 | 6,759 | 7,262 | 7,285 | 7,375 | 7,160 | 6,806 | 6,508 | 6,363 | 5,923 | 5,735 | 5,452 | 5,731 |
| Other unfinished oils | 37,552 | 36,621 | 36,432 | 37,344 | 38,051 | 38,781 | 39,792 | 40,661 | 41,601 | 40,001 | 38,816 | 39,461 | 39,233 |
| | 239,632 | 249,107 | 255,650 | 257,226 | 261,757 | 267,585 | 266,497 | 270,046 | 268,022 | 268,124 | 269,307 | 267,372 | 259,613 |

[1] For comparison with succeeding month.

[2] Subject to revision.

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*Summary of percentage yields of refined products in the United States, 1932–38*

[Computed on total crude runs to stills]

| Product | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|---|---|
| Finished products: | | | | | | | |
| Gasoline [2] | 44.7 | 43.7 | 43.4 | 44.2 | 44.1 | 43.9 | 44.3 |
| Kerosene | 5.3 | 5.7 | 6.0 | 5.8 | 5.2 | 5.5 | 5.5 |
| Gas oil and distillate fuel oils | 8.5 | 9.2 | 10.6 | 10.4 | 11.8 | 12.4 | 13.0 |
| Residual fuel oils | 27.5 | 27.6 | 26.8 | 26.9 | 27.0 | 26.4 | 25.3 |
| Lubricants | 2.7 | 2.8 | 2.9 | 2.9 | 2.9 | 3.0 | 2.6 |
| Wax | .2 | .2 | .2 | .2 | .2 | .2 | .1 |
| Coke | 1.1 | .9 | .7 | .7 | .6 | .6 | .7 |
| Asphalt | 1.7 | 1.5 | 1.8 | 1.8 | 2.0 | 1.9 | 2.1 |
| Road oil | .8 | .6 | .7 | .6 | .7 | .7 | .7 |
| Still gas | 5.0 | 5.2 | 5.0 | 5.3 | 5.3 | 5.4 | 5.4 |
| Other | .2 | .2 | .2 | .2 | .2 | .2 | .2 |
| Unfinished products: | | | | | | | |
| Gasoline | [3] .2 | .5 | [3] .3 | .1 | [4] | [3 4] | [3] .1 |
| Other | | | .2 | [3] .3 | [3] .8 | [3] .7 | [3] .4 |
| Shortage | 2.5 | 1.9 | 1.8 | 1.2 | .8 | .5 | .6 |
| | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

[1] Subject to revision.
[2] Based on total gasoline production less natural gasoline used.
[3] Negative percentage; represents excess percentage rerun over percentage produced.
[4] Less than 0.1 percent.

*Comparative analyses of statistics for motor fuel in 1938, by months*

[Thousands of barrels]

| | 1938 [1] | | | | | | |
|---|---|---|---|---|---|---|---|
| | January | February | March | April | May | June | July |
| Production | 47,681 | 41,762 | 45,352 | 46,025 | 48,159 | 45,718 | 48,913 |
| Daily average | 1,538 | 1,492 | 1,463 | 1,534 | 1,554 | 1,524 | 1,578 |
| Imports | | | | | | | |
| Exports [2] | 3,090 | 3,931 | 3,562 | 4,474 | 4,576 | 4,284 | 4,277 |
| Daily average | 100 | 140 | 115 | 149 | 148 | 143 | 138 |
| Stocks, end of period | 84,065 | 90,035 | 90,566 | 88,863 | 87,535 | 80,676 | 77,838 |
| Domestic demand | 35,176 | 31,861 | 41,259 | 43,254 | 44,911 | 48,293 | 47,474 |
| Daily average | 1,135 | 1,138 | 1,331 | 1,442 | 1,449 | 1,610 | 1,531 |

| | 1938—Continued | | | | | | 1937 (total) |
|---|---|---|---|---|---|---|---|
| | August | September | October | November | December | Total | |
| Production | 50,071 | 48,208 | 49,789 | 48,201 | 48,026 | 567,905 | 571,727 |
| Daily average | 1,615 | 1,607 | 1,606 | 1,607 | 1,549 | 1,556 | 1,566 |
| Imports | | 79 | | | | 79 | 144 |
| Exports [2] | 4,829 | 3,528 | 4,526 | 3,698 | 5,423 | 50,198 | 38,306 |
| Daily average | 156 | 118 | 146 | 123 | 175 | 138 | 105 |
| Stocks, end of period | 72,621 | 71,322 | 70,313 | 69,825 | 70,779 | 70,779 | 74,650 |
| Domestic demand | 50,459 | 46,058 | 46,272 | 44,991 | 41,649 | 521,657 | 519,352 |
| Daily average | 1,628 | 1,535 | 1,493 | 1,500 | 1,344 | 1,429 | 1,423 |

[1] Subject to revision.
[2] Includes benzol.

Although in 1936 and 1937 the number of refineries decreased, the total crude-oil capacity continued the upward trend, last interrupted in 1932. There were 551 completed plants on January 1, 1938, compared with 572 the previous year; the daily capacity of these plants rose from 4,294,881 barrels (old basis) on January 1, 1937, to 4,351,151 barrels (new basis) on January 1, 1938.

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The operating ratio, or the percentage of crude runs to capacity, decreased from the relatively high figure of 83 for 1937 to 78 for 1938. The gain in total capacity of excess equipment in 1937 virtually silenced those who claimed that a shortage of some products was imminent, yet it was not enough to alarm those with contrary views. Although at the beginning of 1938 about 800,000 barrels of daily crude-oil capacity remained unused in the operating units besides about 250,000 barrels of idle equipment in "good shape" on that date, most of this is obsolete and constitutes little in the nature of a threat toward overrunning.

*Summary of refinery capacity in the United States, January 1, 1934–38* [1]

| Year | Number | | | | Capacity (barrels per day) | | | |
|---|---|---|---|---|---|---|---|---|
| | Operating | Shut down | Building | Total | Operating | Shut down | Building | Total |
| 1934 | 454 | 137 | 13 | 604 | 3,553,569 | 364,648 | 44,450 | 3,962,667 |
| 1935 | 435 | 196 | 7 | 638 | 3,614,749 | 443,751 | 13,900 | 4,072,400 |
| 1936 | 422 | 210 | 15 | 647 | 3,749,835 | 367,212 | 46,899 | 4,163,946 |
| 1937 | 423 | 149 | 11 | 583 | 3,966,616 | 328,265 | 81,200 | 4,376,081 |
| 1938 | 431 | 120 | 10 | 561 | [2] 3,970,196 | [2] 380,955 | [2] 283,020 | 4,634,171 |

[1] For data on 1914–33 see Minerals Yearbook, 1938, p. 863.
[2] New basis; for complete information see Bureau of Mines Information Circular 7034.

## MOTOR FUEL

Motor-fuel statistics for the year, with the exception of exports, did not differ greatly from those of 1937. Production and stocks at the end of the year were slightly less, and domestic demand was slightly

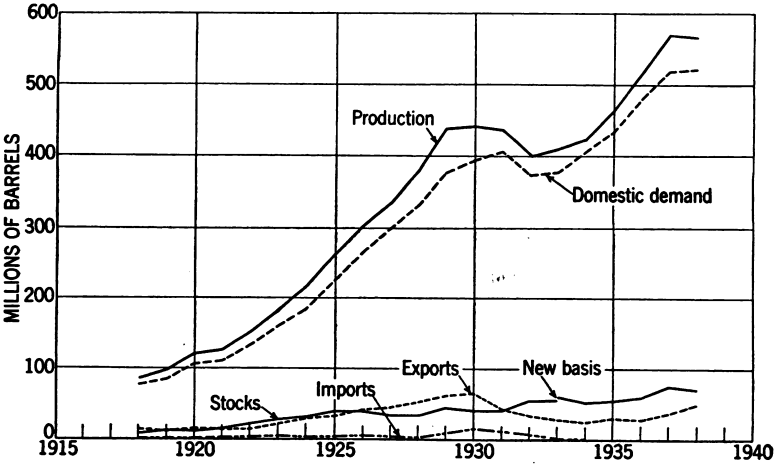


FIGURE 8.—Trends in production, domestic demand, exports, imports, and stocks of motor fuel, 1918–38.

more. Exports, however, showed an increase of 12 million barrels (31 percent). (See fig. 8.)

*Demand.*—The domestic motor-fuel demand in 1938 was 521,657,000 barrels, an increase of one-half of 1 percent over the 1937 record of 519,352,000 barrels. The demand for the first quarter increased 1.9 percent over that for the same quarter of the previous year, but in the months from April to September, inclusive, it was less than in the

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corresponding months of 1937, the July and September figures declining 3.4 and 2.5 percent, respectively. The recovery in business conditions during the fall gave the last quarter of 1938 an increase of 4¼ percent over the last quarter of 1937 and brought the year's demand above that of 1937.

*Domestic demand for motor fuel per motor vehicle in use, 1936–38*

| | 1936 | 1937 | 1938 |
|---|---|---|---|
| Domestic demand for motor fuel ---barrels-- | [1]478,874,000 | [2] 519,352,000 | 521,657,000 |
| Motor vehicles in use July 1 ---number-- | 25,805,900 | [2] 27,571,700 | 28,190,300 |
| Motor-fuel demand per motor vehicle in use: | | | |
| Actual ---barrels-- | 18.56 | [2] 18.84 | 18.50 |
| Based on 1924–31 trend [3] ---do--- | 20.17 | 20.84 | 21.51 |
| Deviation from trend ---do--- | —1.61 | [2] —2.00 | —3.01 |
| Production and trade [4] ---index numbers-- | 88 | 91 | 77 |

[1] Natural-gasoline losses not included.
[2] Revised figures.
[3] Least squares straight-line trend based on 1924–31 data. Depression years have been omitted because they are not normal.
[4] Federal Reserve Bank of New York; computed normal=100.

*Distribution of domestic motor-fuel demand, 1936–38*

[Thousands of barrels]

| | 1936 | 1937 [1] | 1938 [2] |
|---|---|---|---|
| Passenger cars: | | | |
| Highway | 150,896 | 161,302 | 161,390 |
| City | 170,128 | 182,614 | 185,963 |
| Total passenger cars | 321,024 | 343,916 | 347,353 |
| Trucks: | | | |
| Highway | 35,462 | 39,723 | 40,649 |
| City | 57,643 | 63,084 | 60,973 |
| Total trucks | 93,105 | 102,807 | 101,622 |
| Busses | 14,500 | 15,500 | 15,300 |
| Total automotive demand [3] | 428,629 | 462,223 | 464,275 |
| Other demand | 52,977 | 57,129 | 57,382 |
| Grand total | 481,606 | 519,352 | 521,657 |

[1] Revised figures. [2] Subject to revision. [3] 89 percent of total motor-fuel demand.

New motor-vehicle registrations in 1938 dropped to 2,256,000 compared with 4,102,000 in 1937. Preliminary calculations of cars in use on July 1 as shown in the accompanying table indicate an increase of approximately 618,000 vehicles to 28,190,000 compared with 27,572,000 for July 1, 1937. Gasoline consumption per motor vehicle in use was 18.50 barrels for 1938 compared with 18.84 barrels for 1937.

The export demand for gasoline increased from 38,306,000 barrels in 1937 to 50,198,000 in 1938. Part of these exports undoubtedly have been for the purpose of building up stocks for military purposes, but because of the secrecy involved it is difficult to estimate how much has gone into such storage. It is almost a certainty, considering the greater number of motor vehicles and improved highways in foreign countries, that part of this increase in exports represents a permanent increase in demand and will remain a future market for the United States if not supplied by other sources. More detailed information on exports and imports is given in another section of this chapter.

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*Production of gasoline in the United States in 1938, by methods of manufacture, districts, and months*

[Thousands of barrels]

| Method and district | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Straight run: | | | | | | | | | | | | | |
| East Coast | 2,599 | 2,315 | 2,555 | 2,450 | 2,460 | 2,469 | 2,369 | 2,628 | 2,589 | 2,664 | 2,520 | 2,452 | 30,070 |
| Appalachian | 768 | 694 | 588 | 672 | 673 | 637 | 725 | 718 | 705 | 713 | 734 | 744 | 8,371 |
| Indiana, Illinois, Kentucky, etc | 3,114 | 2,787 | 3,148 | 3,163 | 3,454 | 3,316 | 3,466 | 3,315 | 3,326 | 3,752 | 3,302 | 3,334 | 39,477 |
| Oklahoma, Kansas, and Missouri | 2,544 | 2,398 | 2,809 | 2,908 | 3,014 | 2,964 | 3,141 | 3,013 | 2,789 | 2,807 | 2,750 | 2,615 | 33,752 |
| Texas Inland | 1,929 | 1,666 | 1,737 | 1,759 | 1,734 | 1,734 | 1,923 | 1,712 | 1,744 | 1,610 | 1,720 | 1,523 | 20,791 |
| Texas Gulf Coast | 4,357 | 3,759 | 3,946 | 4,289 | 4,384 | 3,937 | 4,277 | 4,625 | 4,412 | 4,609 | 4,359 | 5,079 | 52,033 |
| Louisiana Gulf Coast | 659 | 615 | 591 | 584 | 679 | 685 | 792 | 879 | 858 | 765 | 953 | 743 | 8,803 |
| Arkansas and Louisiana Inland | 547 | 446 | 541 | 517 | 534 | 491 | 526 | 580 | 544 | 644 | 459 | 578 | 6,407 |
| Rocky Mountain | 606 | 565 | 615 | 524 | 605 | 572 | 657 | 722 | 655 | 633 | 612 | 594 | 7,360 |
| California | 3,628 | 3,022 | 3,239 | 3,174 | 3,267 | 2,930 | 3,144 | 3,332 | 3,312 | 3,186 | 2,988 | 3,132 | 38,354 |
| Total straight run | 20,751 | 18,267 | 19,769 | 20,040 | 20,804 | 19,735 | 21,020 | 21,524 | 20,934 | 21,383 | 20,397 | 20,794 | 245,418 |
| Percent yield [1] | 21.2 | 20.7 | 20.6 | 20.9 | 21.0 | 21.0 | 21.0 | 21.2 | 21.6 | 21.2 | 21.0 | 21.2 | 21.1 |
| Cracked: | | | | | | | | | | | | | |
| East Coast | 3,745 | 2,888 | 3,210 | 3,579 | 3,806 | 3,654 | 3,696 | 3,773 | 3,442 | 3,450 | 3,554 | 3,482 | 42,279 |
| Appalachian | 889 | 819 | 789 | 887 | 920 | 953 | 982 | 941 | 899 | 917 | 830 | 914 | 10,740 |
| Indiana, Illinois, Kentucky, etc | 4,183 | 3,808 | 4,011 | 3,973 | 4,234 | 4,100 | 4,408 | 4,472 | 4,575 | 4,568 | 4,754 | 4,460 | 51,546 |
| Oklahoma, Kansas, and Missouri | 2,165 | 1,895 | 1,910 | 2,263 | 2,364 | 2,194 | 2,309 | 2,406 | 2,248 | 2,208 | 2,021 | 2,212 | 26,195 |
| Texas Inland | 1,234 | 1,239 | 1,147 | 1,227 | 1,295 | 1,317 | 1,313 | 1,417 | 1,241 | 1,328 | 1,307 | 1,283 | 15,348 |
| Texas Gulf Coast | 6,755 | 5,703 | 6,673 | 6,398 | 6,917 | 6,405 | 7,119 | 7,425 | 6,865 | 7,393 | 7,112 | 6,802 | 81,567 |
| Louisiana Gulf Coast | 784 | 673 | 641 | 625 | 678 | 511 | 663 | 646 | 625 | 706 | 664 | 643 | 7,859 |
| Arkansas and Louisiana Inland | 323 | 274 | 287 | 290 | 314 | 264 | 285 | 315 | 275 | 343 | 335 | 326 | 3,631 |
| Rocky Mountain | 472 | 399 | 441 | 428 | 525 | 472 | 507 | 512 | 490 | 480 | 528 | 502 | 5,756 |
| California | 1,897 | 1,776 | 2,005 | 2,016 | 1,989 | 2,007 | 2,370 | 2,281 | 2,389 | 2,469 | 2,274 | 2,077 | 25,550 |
| Total cracked | 22,447 | 19,474 | 21,114 | 21,686 | 23,042 | 21,877 | 23,652 | 24,188 | 23,049 | 23,862 | 23,379 | 22,701 | 270,471 |
| Percent yield [1] | 22.9 | 22.1 | 22.0 | 22.7 | 23.2 | 23.3 | 23.7 | 23.9 | 23.7 | 23.7 | 24.0 | 23.2 | 23.2 |
| Total production including natural gasoline: | | | | | | | | | | | | | |
| East Coast | 6,481 | 5,290 | 5,875 | 6,089 | 6,312 | 6,189 | 6,120 | 6,481 | 6,167 | 6,246 | 6,208 | 6,089 | 73,547 |
| Appalachian | 1,685 | 1,536 | 1,396 | 1,575 | 1,610 | 1,608 | 1,729 | 1,685 | 1,627 | 1,653 | 1,590 | 1,686 | 19,380 |
| Indiana, Illinois, Kentucky, etc | 7,664 | 6,889 | 7,508 | 7,430 | 8,000 | 7,701 | 8,218 | 8,084 | 8,331 | 8,814 | 8,612 | 8,260 | 95,511 |
| Oklahoma, Kansas, and Missouri | 5,230 | 4,760 | 5,242 | 5,529 | 5,739 | 5,528 | 5,842 | 5,838 | 5,619 | 5,695 | 5,350 | 5,347 | 65,719 |
| Texas Inland | 3,716 | 3,483 | 3,410 | 3,480 | 3,564 | 3,562 | 3,713 | 3,604 | 3,487 | 3,568 | 3,727 | 3,450 | 42,764 |
| Texas Gulf Coast | 11,804 | 9,766 | 11,034 | 11,175 | 11,729 | 10,712 | 11,855 | 12,474 | 11,619 | 12,662 | 12,168 | 12,665 | 139,663 |
| Louisiana Gulf Coast | 1,494 | 1,330 | 1,287 | 1,246 | 1,381 | 1,211 | 1,472 | 1,549 | 1,514 | 1,491 | 1,652 | 1,417 | 17,044 |
| Arkansas and Louisiana Inland | 929 | 784 | 887 | 855 | 903 | 811 | 882 | 964 | 887 | 1,063 | 861 | 949 | 10,775 |
| Rocky Mountain | 1,166 | 1,043 | 1,132 | 1,002 | 1,161 | 1,067 | 1,196 | 1,266 | 1,203 | 1,213 | 1,260 | 1,210 | 13,919 |
| California | 6,586 | 5,588 | 6,345 | 6,201 | 6,246 | 5,858 | 6,580 | 6,717 | 6,858 | 7,272 | 6,570 | 6,707 | 77,528 |
| Total United States: 1938 | 46,755 | 40,469 | 44,116 | 44,582 | 46,645 | 44,247 | 47,607 | 48,662 | 47,312 | 49,677 | 47,998 | 47,780 | 555,850 |
| 1937 | 43,630 | 40,782 | 44,621 | 44,475 | 46,769 | 45,748 | 48,271 | 49,002 | [2] 49,683 | [2] 51,223 | 47,873 | 47,064 | [2] 559,141 |

[1] Based on crude runs to stills.

[2] Revised figures—straight run, Louisiana Gulf Coast, September revised to 892, October to 700, and total to 8,669 (Minerals Yearbook, 1938, p. 867).

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*Production.*—Motor-fuel production was 3,822,000 barrels less than the 1937 figure of 571,727,000 barrels. The 1938 production of 567,905,000 barrels comprises 245,418,000 barrels of straight-run gasoline, 270,471,000 of cracked gasoline, 39,961,000 of blended natural gasoline, 10,356,000 of unblended natural gasoline, and 1,699,000 of benzol. The ratio of straight-run gasoline to total motor-fuel production continued its trend, dropping from 44.0 percent in 1937 to 43.2 in 1938, while that of cracked gasoline continued its increase, rising from 46.9 percent in 1937 to 47.6 in 1938. The ratio of natural gasoline increased from 8.6 percent in 1937 to 8.9 in 1938, while that of benzol declined from 0.5 to 0.3 percent. The decline of 39 percent in benzol production probably resulted from curtailing steel-mill operations, which dropped from an average of 61 percent of capacity in 1937 to 25 percent in 1938.

*Yields.*—The downward trend in gasoline yields was broken in 1938 when straight-run and cracked production comprised 44.3 percent of crude runs to stills compared with 43.9 percent in 1937. Almost one-half of this increase, however, represents a gain in production contributed by unfinished gasoline, stocks of which declined 1,616,000 barrels during the year.

The demand for increasingly better gasoline, both for automobiles and for airplanes, has put pressure on refiners to produce motor fuel with ever higher octane rating. Octane qualifications first appeared on October 19, 1931, when a 57–65 octane rating was required for regular-grade gasoline. This was changed on May 8, 1933, to 60–64 octane; on August 6, 1934, to 63–70 octane; on April 15, 1935, to 68–70 octane; and on April 20, 1937, to 67–69 octane. Army airplanes and many air-transport planes now require 100 octane fuel.

The two principal methods open to refiners for increasing the octane rating of their motor fuel are to add tetraethyl lead and to re-form. The loss by re-forming, or cracking, gasoline has been one of the most expensive losses, probably around 20 to 25 percent.

During recent years the polymerization process has been developing; it is somewhat the antithesis of cracking, whereby the lighter molecules, such as those of still gas and natural gas, are converted into heavier molecules to make gasoline. The principal source of charging stock for the polymerization units now in operation is the gas from the cracking stills. Although the quantity of gasoline produced by polymerization is extremely small, it has some influence toward raising gasoline yields.

Of importance for the future is the rapid development of new catalytic cracking processes, which increase the yield of the lighter products of petroleum considerably.

The yield of cracked gasoline continued its upward trend by increasing from 22.7 percent in 1937 to 23.2 in 1938, but the yield of straight-run gasoline remained virtually the same at 21.1 percent, 0.2 percent lower than in 1937.

During the early part of the year gasoline yields were low, dropping to 42.6 percent in March. From this point they rose steadily to 45.3 percent in September, a point that had not been exceeded since September 1933.

Among the districts, Inland Texas is noteworthy because of its continuous upward trend, the yield having increased approximately 6 percent in the last 3 years. The 1938 yield was 54.0 percent compared with 51.2 percent in 1937.

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*Prices.*—The average refinery price per gallon of regular-grade Oklahoma gasoline for 1938 was 4.90 cents compared with 5.81 cents in 1937 and 5.95 in 1936. The price at the beginning of the year was 4.75 cents and rose to a peak of 5.38 cents during the summer, but subsequently declined to close the year at 4.38 cents.

The average service-station price of regular-grade gasoline (ex-tax), as compiled by the American Petroleum Institute, dropped from 14.58 cents per gallon in 1937 to 14.07 cents in 1938. The price on January 1—14.29 cents—was the highest of the year, from which it declined almost every month to reach a low of 13.32 cents on January 1, 1939.

The greatest change in price (3.5 cents) was in Salt Lake City, Utah, where the price slid from 18.5 cents on January 1, 1938, to 15.0 cents on January 1, 1939. Louisville, Ky., with a change of 2.3 cents—from 14.0 cents to 11.7—was next in magnitude, and New York City and Hartford, Conn., followed with changes of 2.0 cents each. The Atlantic Coast area, with an average price decline of 0.81 cents, suffered the heaviest slump. This group, however, includes Philadelphia, where the 1.5-cent price increase from 11.75 to 13.25 cents was the greatest of any city.

In general, the Rocky Mountain States had the highest gasoline prices with averages ex-tax, at the beginning and closing of the year, of 16.75 and 16.25 cents, respectively. Boise, Idaho, with a price of 25.5 cents per gallon, including 6 cents in taxes, had the highest price of any city on January 1 but dropped out of that position during the year. Spokane, Wash., and Helena, Mont., where gasoline sold for 24 cents per gallon, including 6 cents in taxes, had the highest prices at the end of the year, and New Orleans came next with a 23.5-cent price, including 10 cents in taxes.

Wichita, Kans., had the lowest-price gasoline at 14.1 cents per gallon, including 4 cents in taxes, which was effective the last half of the year. However, as a group, the North Atlantic Coast States had the lowest prices. The averages for this section at the beginning and the end of the year were respectively, 12.83 and 12.02 cents, extax. Springfield, Mass., and Providence, R. I., in this group, where gasoline sold for 15 cents per gallon, including 4 cents in taxes, had the next lowest price to Wichita.

The posted price, however, is not necessarily the price the customer pays for his gasoline, discounts of 1 to 3 cents per gallon being customary in many parts of the country. Several attempts have been made to stop price cutting. It was prohibited in the oil code of N. R. A. days. The Wisconsin State Department fixed minimum prices for gasoline in 1934, and Iowa and Pennsylvania passed price-posting laws in 1937, while a similar law was vetoed in Illinois. California, in the same year, not only amended her Unfair Practices Act and Unfair Trade Act to strengthen oil marketing, but also her Oil Substitution Act originally passed in 1931 and amended in 1933, to require the posting and maintenance of the actual selling price. New Jersey passed a price-posting law that became effective June 1, 1938, which is a companion to the law permitting resale-price maintenance contracts between the dealer and service-station operator.

Although the difficulty of obtaining convictions under these acts has raised some question as to their effectiveness, a recent favorable decision in the Superior Court in Los Angeles has been followed by a number of arrests in California. Reports indicate that the New Jersey law has improved the price situation in that State. A few

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convictions have been obtained, but the cases were not appealed, so there has been no real test of the law as yet.

The 50-city average dealer's net price—10.18 cents on January 1, 1938—declined steadily throughout the year. However, the average price of 9.56 cents on January 1, 1939, was only 0.62 cent lower than that at the beginning of the year. The yearly average was 10.43 cents compared with 10.53 cents for 1937.

The year 1938 was the first in which there was no change in gasoline taxes, with the possible exception of some local levies in the less important places. State taxes remained at an average of 4.44 cents per gallon throughout the year, and the 1-cent Federal tax was in effect throughout the year. In addition to these taxes, there were numerous municipal and county taxes.

During 1938 one State (Missouri) and the District of Columbia had a tax rate of 2 cents, 10 States a tax rate of 3 cents, 18 States a tax rate of 4 cents, 10 States a tax rate of 5 cents, 5 states a tax rate of 6 cents, 1 State a tax rate of 6½ cents, and 3 States a tax rate of 7 cents.

*Average monthly prices of gasoline, 1937–38, in cents per gallon*

| | January | February | March | April | May | June | July | August | September | October | November | December | Average for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| 68–70 octane[1] at refineries in Oklahoma[2] | 5.75 | 5.94 | 5.84 | 6.13 | 6.19 | 6.16 | 6.06 | 6.06 | 5.91 | 5.69 | 5.10 | 4.86 | 5.81 |
| Dealer's net at 50 cities[3] | 10.21 | 10.32 | 10.55 | 10.63 | 10.64 | 10.66 | 10.51 | 10.66 | 10.66 | 10.63 | 10.58 | 10.30 | 10.53 |
| Service-station at 50 cities (including tax)[3] | 18.47 | 18.47 | 18.83 | 19.07 | 19.16 | 19.13 | 19.12 | 19.21 | 19.16 | 19.25 | 19.12 | 18.85 | 18.99 |
| 1938 | | | | | | | | | | | | | |
| 67–69 octane at refineries in Oklahoma[2] | 4.75 | 4.75 | 4.81 | 4.94 | 4.90 | 5.16 | 5.38 | 5.35 | 5.11 | 4.68 | 4.58 | 4.41 | 4.90 |
| Dealer's net at 50 cities[3] | 10.18 | 10.16 | 10.09 | 10.22 | 10.17 | 10.14 | 10.13 | 10.18 | 10.05 | 9.82 | 9.70 | 9.67 | 10.43 |
| Service-station at 50 cities (including tax)[3] | 18.73 | 18.72 | 18.69 | 18.67 | 18.62 | 18.66 | 18.60 | 18.64 | 18.46 | 18.20 | 18.13 | 17.96 | 18.51 |

[1] Changed to 67–69 octane Sept. 20.
[2] National Petroleum News.
[3] American Petroleum Institute.

*Price differentials for 60–64 octane gasoline at New York and on the Gulf coast, 1937–38,[1] in cents per gallon*

| | Price on Gulf coast | Tanker rate, Gulf coast to New York | Cost at New York | Price at New York | Differential between price and cost at New York |
|---|---|---|---|---|---|
| Average 1937 | 5.99 | 0.94 | 6.93 | 6.88 | −0.05 |
| Average 1938 | 5.02 | .51 | 5.53 | 6.19 | +.66 |
| December 1938 | 4.50 | .67 | 5.17 | 5.88 | +.71 |

[1] National Petroleum News.

*Stocks.*—Finished gasoline stocks totaled 65,949,000 barrels on December 31, 1938, 3,943,000 barrels less than on December 31, 1937. None of the districts had greater stocks than at the close of 1937. The largest decrease was in the East Coast district, which declined 1,024,000 barrels compared with an increase of 4,000,000 barrels in 1937.

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Stocks of gasoline began to increase abnormally fast late in 1937 and reached a record peak at the end of March 1938 when stocks, including 7,285,000 barrels of unfinished gasoline, amounted to 92,320,000 barrels. Although crude runs to stills were greater than was considered desirable, they were restricted enough to reduce stocks almost to a normal level by the end of the year. Referring to the table of days' supply of motor fuel on hand it may be seen that the peak stocks at the end of March 1938 were 5.3 days' supply more of finished gasoline than those for March 31, 1937. As the year progressed, however, days' supply of gasoline approached nearer normal.

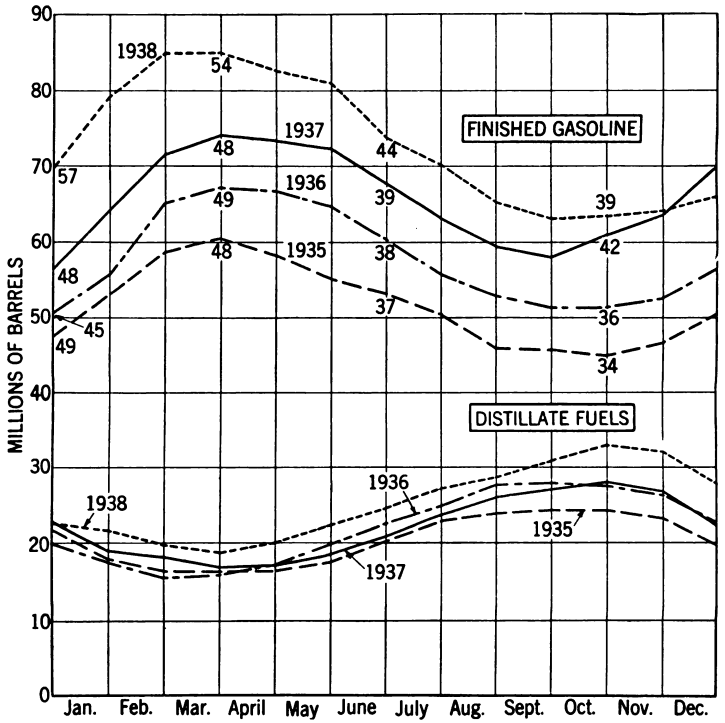


FIGURE 9.—Stocks of finished gasoline and distillate fuels, 1935–38, by months.

until on December 31, it was less than 2 days more than on December 31, 1936 and over 7 days less than on December 31, 1937.

Seasonal variations in gasoline stocks in recent years are shown in figure 9, which gives the quantity of finished gasoline stocks in millions of barrels for the last day of each month from December 1934 to December 1938, together with equivalent days' supply at certain periods. The figures for days' supply on the chart represent the quantity of finished gasoline on hand at the end of a month divided by the total demand for the succeeding month; they are the same as shown in the accompanying table.

Figure 9 also includes stocks of distillate fuels for the same period to bring out the contrast in seasonal variations in stocks of the two products. It may be seen that distillate fuel stocks were materially higher in 1938 than in the 3 previous years, particularly in October, November, and December.

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*Stocks of gasoline in the United States in 1938, by districts and months*

[Thousands of barrels]

| District | Jan. 31 | Feb. 28 | Mar. 31 | Apr. 30 | May 31 | June 30 | July 31 | Aug. 31 | Sept. 30 | Oct. 31 | Nov. 30 | Dec. 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Finished gasoline: | | | | | | | | | | | | |
| Refinery: | | | | | | | | | | | | |
| East Coast | 7,437 | 8,161 | 8,997 | 8,519 | 7,802 | 7,294 | 6,248 | 6,150 | 5,684 | 4,804 | 4,841 | 5,192 |
| Appalachian | 1,649 | 1,882 | 1,752 | 1,666 | 1,475 | 1,313 | 1,318 | 1,141 | 1,043 | 1,034 | 1,064 | 1,252 |
| Indiana, Illinois, Kentucky, etc | 9,461 | 11,159 | 11,701 | 11,031 | 9,898 | 8,540 | 7,894 | 6,472 | 6,212 | 5,660 | 5,642 | 6,286 |
| Oklahoma, Kansas, and Missouri | 4,792 | 5,219 | 4,722 | 5,024 | 5,018 | 4,315 | 3,898 | 3,603 | 3,504 | 3,666 | 3,651 | 3,913 |
| Texas Inland | 2,373 | 2,686 | 2,657 | 2,575 | 2,518 | 2,126 | 2,007 | 1,836 | 1,567 | 1,649 | 1,848 | 1,857 |
| Texas Gulf Coast | 11,373 | 12,683 | 12,536 | 12,050 | 11,124 | 8,910 | 8,322 | 8,800 | 8,807 | 9,183 | 8,586 | 9,419 |
| Louisiana Gulf Coast | 1,545 | 1,470 | 1,485 | 1,372 | 1,548 | 1,586 | 1,604 | 1,360 | 1,216 | 1,142 | 1,277 | 1,239 |
| Arkansas and Louisiana Inland | 545 | 527 | 523 | 592 | 528 | 426 | 432 | 420 | 400 | 412 | 354 | 399 |
| Rocky Mountain | 2,165 | 2,532 | 2,549 | 2,493 | 2,531 | 2,180 | 1,810 | 1,410 | 1,232 | 1,203 | 1,306 | 1,435 |
| California | 11,879 | 12,626 | 13,121 | 12,338 | 11,568 | 10,469 | 9,558 | 8,945 | 9,154 | 9,986 | 10,807 | 10,813 |
| Total United States | 53,219 | 58,945 | 60,043 | 57,660 | 54,010 | 47,159 | 43,091 | 40,137 | 38,819 | 38,739 | 39,376 | 41,805 |
| Bulk terminal and pipe line: | | | | | | | | | | | | |
| East Coast | 12,911 | 13,043 | 13,060 | 13,205 | 14,524 | 14,158 | 14,374 | 12,566 | 12,393 | 11,995 | 12,163 | 11,405 |
| Appalachian | 1,803 | 1,908 | 1,767 | 1,714 | 1,848 | 1,788 | 1,851 | 1,860 | 1,819 | 1,826 | 1,788 | 1,742 |
| Indiana, Illinois, Kentucky, etc | 4,566 | 4,227 | 3,436 | 3,585 | 4,284 | 4,412 | 4,708 | 4,317 | 4,383 | 5,177 | 5,275 | 5,247 |
| Oklahoma, Kansas, and Missouri | 2,573 | 2,878 | 2,772 | 2,817 | 2,594 | 2,444 | 2,361 | 2,243 | 2,190 | 2,139 | 2,299 | 2,339 |
| Texas Inland | 90 | 122 | 117 | 98 | 69 | 98 | 83 | 69 | 92 | 134 | 86 | 54 |
| Texas Gulf Coast | 556 | 632 | 738 | 501 | 368 | 317 | 363 | 322 | 294 | 313 | 269 | 207 |
| Louisiana Gulf Coast | 695 | 599 | 636 | 636 | 724 | 677 | 612 | 507 | 530 | 550 | 555 | 604 |
| Arkansas and Louisiana Inland | 138 | 155 | 140 | 126 | 157 | 166 | 196 | 155 | 126 | 140 | 174 | 167 |
| California | 2,563 | 2,509 | 2,326 | 2,342 | 2,409 | 2,506 | 2,585 | 2,423 | 2,517 | 2,529 | 2,098 | 2,379 |
| Total United States | 25,895 | 26,073 | 24,992 | 25,024 | 26,977 | 26,566 | 27,133 | 24,462 | 24,344 | 24,803 | 24,707 | 24,144 |
| Unfinished gasoline: | | | | | | | | | | | | |
| East Coast | 991 | 1,166 | 1,192 | 1,285 | 1,139 | 1,110 | 1,139 | 1,110 | 1,083 | 1,062 | 980 | 1,000 |
| Appalachian | 242 | 256 | 269 | 265 | 306 | 308 | 271 | 279 | 294 | 242 | 241 | 239 |
| Indiana, Illinois, Kentucky, etc | 969 | 952 | 835 | 861 | 865 | 750 | 707 | 711 | 599 | 537 | 492 | 586 |
| Oklahoma, Kansas, and Missouri | 605 | 734 | 758 | 590 | 497 | 436 | 420 | 420 | 384 | 414 | 420 | 381 |
| Texas Inland | 290 | 297 | 273 | 278 | 260 | 274 | 282 | 281 | 265 | 255 | 261 | 250 |
| Texas Gulf Coast | 1,761 | 1,867 | 1,814 | 1,926 | 1,884 | 1,904 | 1,868 | 1,871 | 1,666 | 1,513 | 1,403 | 1,413 |
| Louisiana Gulf Coast | 583 | 441 | 541 | 580 | 633 | 573 | 519 | 412 | 372 | 413 | 335 | 391 |
| Arkansas and Louisiana Inland | 39 | 47 | 21 | 31 | 36 | 27 | 31 | 33 | 30 | 32 | 29 | 30 |
| Rocky Mountain | 119 | 116 | 106 | 121 | 114 | 121 | 95 | 111 | 106 | 104 | 91 | 90 |
| California | 1,160 | 1,386 | 1,476 | 1,438 | 1,426 | 1,303 | 1,176 | 1,135 | 1,124 | 1,163 | 1,200 | 1,351 |
| Total United States | 6,759 | 7,262 | 7,285 | 7,375 | 7,160 | 6,806 | 6,508 | 6,363 | 5,923 | 5,735 | 5,452 | 5,731 |
| Total finished and unfinished gasoline stocks, United States: | | | | | | | | | | | | |
| 1938 | 85,873 | 92,280 | 92,320 | 90,059 | 88,147 | 80,531 | 76,732 | 70,962 | 69,086 | 69,277 | 69,535 | 71,680 |
| 1937 | 71,416 | 78,413 | 81,651 | 80,667 | [1] 79,804 | [1] 75,283 | 70,345 | 66,756 | 65,380 | 68,037 | 70,628 | 76,990 |

[1] Revised figures—stocks of finished gasoline, refinery, East Coast, May 31, revised to 5,625 and June 30 to 5,575; bulk terminal and pipe line, May 31, Appalachian revised to 1,493 and Indiana, Illinois, Kentucky, etc., to 3,347 (Minerals Yearbook, 1938, p. 874).

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*Days' supply of motor fuel on hand in the United States at end of month, 1936–38* [1]

| Month | 1936 | | | 1937 | | | 1938 [2] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Finished gasoline | Natural gasoline | Total motor fuel | Finished gasoline | Natural gasoline | Total motor fuel | Finished gasoline | Natural gasoline | Total motor fuel |
| Jan. | 56.1 | 3.9 | 60.0 | 52.0 | 3.2 | 55.2 | 61.9 | 3.9 | 65.8 |
| Feb. | 53.8 | 3.4 | 57.2 | 51.5 | 3.1 | 54.6 | 58.8 | 3.5 | 62.3 |
| Mar. | 48.7 | 3.2 | 51.9 | 48.2 | 3.1 | 51.3 | 53.5 | 3.4 | 56.9 |
| Apr. | 46.1 | 3.5 | 49.6 | 46.6 | 3.4 | 50.0 | 51.8 | 3.9 | 55.7 |
| May | 41.4 | 3.5 | 44.9 | 42.0 | 3.4 | 45.4 | 46.2 | 3.7 | 49.9 |
| June | 38.3 | 3.6 | 41.9 | 39.1 | 3.6 | 42.7 | 44.2 | 4.1 | 48.3 |
| July | 35.8 | 3.6 | 39.4 | 36.6 | 4.0 | 40.6 | 39.4 | 4.2 | 43.6 |
| Aug. | 34.0 | 3.5 | 37.5 | 34.5 | 4.1 | 38.6 | 39.1 | 4.8 | 43.9 |
| Sept. | 34.1 | 3.3 | 37.4 | 36.7 | 3.8 | 40.5 | 38.5 | 5.0 | 43.5 |
| Oct. | 36.2 | 3.1 | 39.3 | 39.9 | 3.5 | 43.4 | 39.2 | 4.1 | 43.3 |
| Nov. | 39.2 | 3.0 | 42.2 | 47.2 | 3.8 | 51.0 | 42.2 | 3.8 | 46.0 |
| Dec. | 47.6 | 3.4 | 51.0 | 56.6 | 3.9 | 60.5 | 49.3 | 3.6 | 52.9 |

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Subject to revision.

*Production by States.*—Texas led in the production of gasoline, with the output of 182,427,000 barrels or 33 percent of the United States total, compared with only 30 percent in 1937. California, Pennsylvania, Indiana, and Oklahoma followed with 14, 8, 7, and 6 percent, respectively.

*Consumption by States.*—New York still leads in gasoline consumption in 1938, but it declined in relative importance in 1938. New York and California consumed about 8 percent each of the total, Pennsylvania 7 percent, and Illinois, Ohio, and Texas 6 percent each. (See fig. 10.)

*Distribution.*—The amount of motor fuel transported by pipe lines increased from 73,233,000 to 85,297,000 barrels (16 percent). Compared with the 2.5 percent increase in total motor-fuel demand, these statistics indicate that the tendency for the proportion of gasoline transported by pipe lines to increase is continuing.

*Production and consumption of gasoline in the United States, 1936–38, by States*

[Thousands of barrels]

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Production | Consumption [1] | Production | Consumption [1] | Production [2] | Consumption [1] |
| Alabama | (3) | 4,872 | (3) | 5,378 | (3) | 5,483 |
| Arizona | | 2,277 | | 2,473 | | 2,434 |
| Arkansas | 2,768 | 3,672 | 3,006 | 3,908 | 3,028 | 4,050 |
| California | 76,942 | 39,371 | 79,967 | 41,853 | 77,528 | 41,722 |
| Colorado | 729 | 4,875 | 752 | 5,263 | 1,170 | 5,404 |
| Connecticut | | 7,129 | | 7,784 | | 7,606 |
| Delaware | | 1,204 | | 1,302 | | 1,323 |
| District of Columbia | | 3,029 | | 3,262 | | 3,316 |
| Florida | | 7,452 | | 7,831 | | 8,062 |
| Georgia | [4] 995 | 7,267 | [5] 5,332 | 7,899 | [5] 4,990 | 8,066 |
| Idaho | | 2,092 | | 2,253 | (6) | 2,255 |
| Illinois | 23,155 | 28,379 | 26,407 | 30,794 | 28,309 | 31,782 |
| Indiana | 40,227 | 13,780 | 42,940 | 15,091 | 40,737 | 15,046 |
| Iowa | | 10,957 | | 11,807 | | 12,574 |
| Kansas | [7] 30,710 | 10,722 | [7] 32,481 | 11,195 | [7] 31,231 | 11,167 |
| Kentucky | [8] 4,053 | 5,436 | [8] 4,287 | 5,996 | [8] 4,729 | 6,109 |
| Louisiana | [9] 25,724 | 5,152 | [9] 26,405 | 5,679 | [9] 24,791 | 5,899 |
| Maine | | 3,203 | | 3,463 | | 3,449 |
| Maryland | 4,809 | 5,839 | (3) | 6,433 | (3) | 6,475 |
| Massachusetts | [10] 4,863 | 15,661 | [10] 5,586 | 16,583 | [10] 4,625 | 16,432 |
| Michigan | 4,653 | 23,709 | 5,672 | 26,443 | 6,822 | 25,094 |
| Minnesota | | 11,449 | | 12,140 | | 12,612 |

See footnotes at end of table.

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*Production and consumption of gasoline in the United States, 1936–38, by States*—Continued

[Thousands of barrels]

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Production | Consumption | Production | Consumption | Production | Consumption |
| Mississippi | | 4,069 | | 4,519 | | 4,616 |
| Missouri | (7) | 13,514 | (7) | 14,060 | (7) | 14,373 |
| Montana | 1,678 | 2,655 | 2,317 | 2,760 | 2,562 | 2,824 |
| Nebraska | (11) | 5,485 | (11) | 5,455 | (6) | 5,489 |
| Nevada | | 815 | | 890 | | 948 |
| New Hampshire | | 1,926 | | 2,031 | | 2,028 |
| New Jersey | 26,388 | 17,750 | 30,302 | [9]19,538 | 26,214 | 19,748 |
| New Mexico | [12] 2,632 | 1,806 | [12] 3,148 | 2,111 | [12] 3,100 | 2,145 |
| New York | 5,858 | 40,996 | 5,833 | 43,228 | 5,515 | 42,910 |
| North Carolina | | 8,289 | | 9,272 | | 9,546 |
| North Dakota | | 2,652 | | 2,899 | | 3,031 |
| Ohio | 19,520 | 28,642 | 22,323 | 31,161 | 21,517 | 30,448 |
| Oklahoma | 35,122 | 8,808 | 37,095 | 9,284 | 34,488 | 9,564 |
| Oregon | | 5,138 | | 5,401 | | 5,469 |
| Pennsylvania | 43,031 | 30,554 | 46,164 | 33,749 | 43,353 | 33,419 |
| Rhode Island | (10) | 2,818 | (10) | 2,913 | (10) | 2,881 |
| South Carolina | (4) | 3,903 | (5) | 4,480 | (5) | 4,656 |
| South Dakota | (11) | 2,700 | (11) | 2,708 | (6) | 3,080 |
| Tennessee | (8) | 6,341 | (8) | 6,355 | (8) | 6,717 |
| Texas | 142,675 | 26,362 | 170,279 | 29,054 | 182,427 | 30,245 |
| Utah | (12) | 1,985 | (12) | 2,169 | (12) | 2,209 |
| Vermont | | 1,429 | | 1,567 | | 1,531 |
| Virginia | | 7,537 | | 8,158 | | 8,456 |
| Washington | | 7,607 | | 7,964 | | 8,046 |
| West Virginia | 1,474 | 4,317 | 1,598 | 4,672 | 1,627 | 4,532 |
| Wisconsin | | 12,012 | | 12,883 | | 12,916 |
| Wyoming | [11] 6,805 | 1,397 | [11] 7,247 | 1,524 | [9] 7,087 | 1,478 |
| Total United States | 504,811 | 469,034 | [9] 559,141 | 505,635 | 555,850 | 509,665 |

[1] American Petroleum Institute.
[2] Subject to revision.
[3] Alabama included with Louisiana.
[4] South Carolina included with Georgia.
[5] South Carolina and Maryland included with Georgia.
[6] Idaho, Nebraska, and South Dakota included with Wyoming.
[7] Missouri included with Kansas.
[8] Tennessee included with Kentucky.
[9] Revised figures.
[10] Rhode Island included with Massachusetts.
[11] Nebraska and South Dakota included with Wyoming.
[12] Utah included with New Mexico.

*Shipments of motor fuel by pipe lines in the United States in 1938, by months*

[Thousands of barrels]

| | 1938 | | | | | | | | | | | | | 1937 (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total | |
| Motor fuel turned into lines | 6,192 | 5,391 | 6,318 | 6,473 | 7,233 | 7,382 | 7,518 | 8,335 | 7,965 | 7,789 | 7,604 | 7,392 | 85,592 | 74,147 |
| Motor fuel delivered from lines | 5,997 | 5,074 | 6,368 | 6,606 | 7,274 | 7,288 | 7,670 | 8,447 | 7,854 | 7,912 | 7,521 | 7,286 | 85,297 | 73,233 |
| Shortage | 20 | 2 | 23 | 34 | 31 | 20 | 34 | 48 | 30 | 34 | 34 | 20 | 330 | 260 |
| Stocks in lines and working tanks, end of month | 3,537 | 3,852 | 3,779 | 3,612 | 3,540 | 3,614 | 3,428 | 3,268 | 3,349 | 3,192 | 3,241 | 3,327 | 3,327 | [1] 3,362 |

[1] Revised figures.

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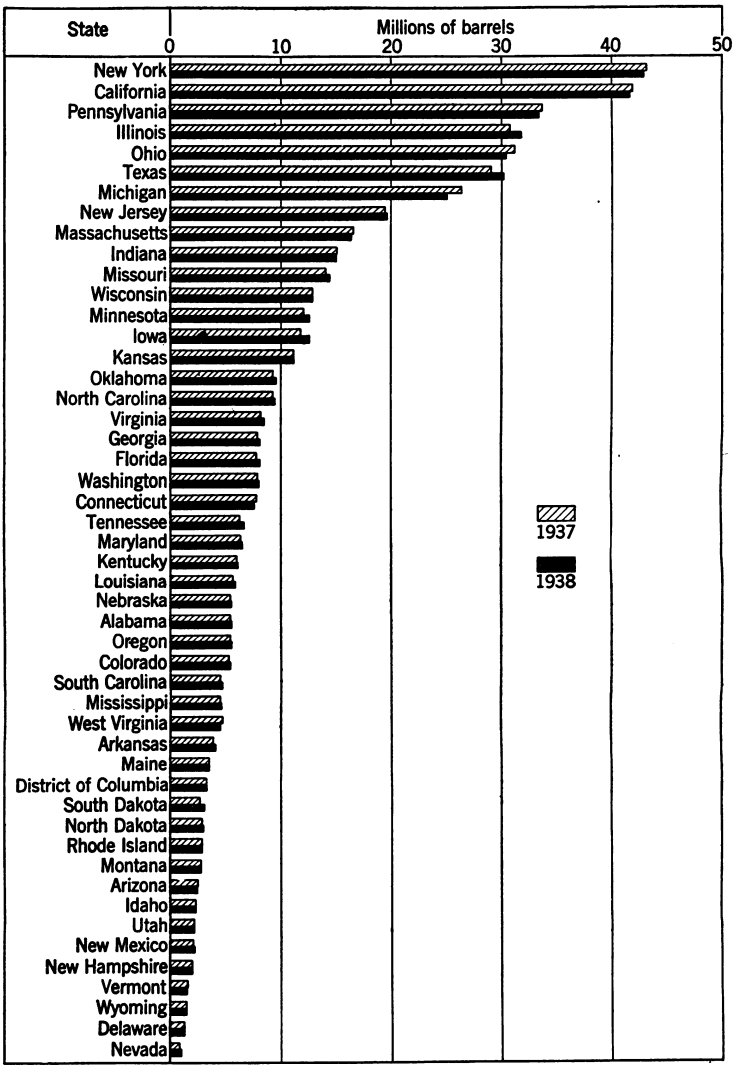


FIGURE 10.—Gasoline consumption, 1937–38, by States.

Boat shipments of gasoline from California to the East coast decreased from 4,144,000 barrels in 1937 to 2,965,000 in 1938, but the tanker movement from the Gulf coast to the East coast, which includes virtually all of the gasoline movement between these points, rose from 104,127,000 barrels in 1937 to 105,036,000 in 1938.

A comparison of prices at Gulf coast points and New York Harbor is interesting in connection with this movement. During 1937 the average price of gasoline in New York was 0.05 cent less per gallon than the average Gulf coast price plus the tanker rate to New York. In 1938, however, the average price of gasoline in New York was 0.66 cent more than the average Gulf coast price plus the tanker rate, and in December 1938 it was 0.71 cent more. The accompanying table shows these relationships in more detail.

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## KEROSENE AND RANGE OIL[2]

Kerosene statistics for 1938 show increased domestic demand and higher year-end stocks than in 1937, but production and exports in 1938 were below the 1937 totals. The production of kerosene dropped from 65,308,000 barrels in 1937 to 64,580,000 in 1938. This lower output of kerosene can be attributed to the running of slightly less crude oil to stills, as there was no change in the percentage of kerosene yield, which averaged 5.5 percent for both years. Domestic demand for kerosene increased from 54,972,000 barrels in 1937 to 56,351,000 in 1938, or by less than 3 percent, a gain somewhat below the average for recent years. A review of the kerosene domestic demand figures by quarterly totals reveals that a gain in the first quarter of 1938 over the same period of 1937 about equaled the net increase of 1,400,000 barrels for the entire year. Furthermore, demand in the second quarter of 1938 declined about 700,000 barrels in comparison with the same quarter of 1937, but this loss was made up by nominal gains realized in the closing quarters of the year.

*Comparative analyses of statistics for kerosene in the United States, 1937–38, by months and districts*

| | Production (thousands of barrels) | | Yield (percent) | | Domestic demand (thousands of barrels) | | Stocks (thousands of barrels) | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938[1] | 1937 | 1938[1] | 1937 | 1938[1] | 1937 | 1938[1] |
| By months: | | | | | | | | |
| January | 5,923 | 5,638 | 6.3 | 5.8 | [3] 5,286 | 5,360 | 5,622 | 6,523 |
| February | 4,866 | 5,167 | 5.7 | 5.9 | [3] 4,225 | 5,017 | 5,443 | 5,986 |
| March | 5,187 | 5,798 | 5.5 | 6.0 | [3] 4,820 | 5,150 | 5,396 | 6,093 |
| April | 4,907 | 5,445 | 5.2 | 5.7 | 4,465 | 4,333 | 5,047 | 6,394 |
| May | 5,343 | 5,649 | 5.3 | 5.7 | [3] 4,149 | 3,637 | 5,576 | 7,627 |
| June | 5,087 | 5,235 | 5.1 | 5.6 | 3,259 | 3,257 | 6,781 | 9,202 |
| July | 5,482 | 4,889 | 5.2 | 4.9 | 3,594 | 3,752 | 7,553 | 10,112 |
| August | 5,726 | 4,933 | 5.4 | 4.9 | 3,667 | 4,292 | 8,637 | 10,149 |
| September | 5,371 | 5,348 | 5.2 | 5.5 | 4,397 | 4,187 | 8,839 | 10,497 |
| October | 5,731 | 5,320 | 5.5 | 5.5 | 4,985 | 5,185 | 8,877 | 9,949 |
| November | 5,876 | 5,419 | 5.9 | 5.6 | 5,705 | 5,368 | 8,357 | 9,676 |
| December | 5,809 | 5,739 | 5.9 | 5.9 | 6,420 | 6,813 | 7,083 | 7,799 |
| Total United States | 65,308 | 64,580 | 5.5 | 5.5 | [3] 54,972 | 56,351 | 7,083 | 7,799 |
| By districts: | | | | | | | | |
| East Coast | 11,024 | 9,208 | 5.6 | 5.1 | | | 1,512 | 1,356 |
| Appalachian | 3,220 | 2,769 | 8.0 | 7.1 | | | 132 | 184 |
| Indiana, Illinois, Kentucky, etc | 6,238 | 7,096 | 3.8 | 4.3 | | | 558 | 702 |
| Oklahoma, Kansas, and Missouri | 7,396 | 6,960 | 6.1 | 6.3 | | | 620 | 743 |
| Texas Inland | 3,515 | 2,985 | 4.7 | 4.5 | [3] | [3] | 178 | 189 |
| Texas Gulf Coast | 20,351 | 22,357 | 7.2 | 7.3 | | | 2,095 | 2,722 |
| Louisiana Gulf Coast | 5,927 | 6,037 | 11.7 | 12.9 | | | 822 | 527 |
| Arkansas and Louisiana Inland | 1,787 | 2,139 | 7.2 | 8.9 | | | 173 | 192 |
| Rocky Mountain | 796 | 810 | 3.4 | 3.3 | | | 120 | 79 |
| California | 5,054 | 4,219 | 2.5 | 2.1 | | | 873 | 1,105 |
| Total United States | 65,308 | 64,580 | 5.5 | 5.5 | [3] 54,972 | 56,351 | 7,083 | 7,799 |

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

[2] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

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Kerosene stocks increased from 7,083,000 barrels at the end of 1937 to 7,799,000 at the close of 1938. The 700,000 barrels of kerosene added to storage in 1938 is approximately half the stock increase in 1937. The smaller amount added to stocks in 1938 is directly connected with the lower production of kerosene for that year, as a gain of about 1,400,000 barrels in domestic demand was offset by a similar loss in exports.

Exports of kerosene dropped from 8,886,000 barrels in 1937 to 7,513,000 in 1938, the first decline in overseas trade since 1935. Many countries required less American kerosene in 1938 than in 1937; however, purchases by Denmark, Sweden, the United Kingdom, Canada, and the Philippines gained in 1938.

Annual surveys prior to 1937 covered only that portion of kerosene sold as range oil; however, petroleum refiners and jobbers were requested to report to the Bureau of Mines for 1937 all kerosene deliveries by States and principal uses. The 1937 returns show kerosene sales of 54,551,000 barrels, divided as follows: Sold as range oil, 30,099,000 barrels; tractor fuel, 4,251,000 barrels; and all other uses, 20,201,000 barrels.

*Sales of range oil in the United States, 1935–37, by States* [1]

[Thousands of barrels]

| State | 1935 | 1936 | 1937 | |
|---|---|---|---|---|
| | | | Total | Percent of total |
| Massachusetts | 7,203 | 8,219 | 9,645 | 29.6 |
| New York | 3,222 | 4,811 | 5,817 | 17.8 |
| Connecticut | 2,223 | 2,511 | 2,972 | 9.1 |
| New Jersey | 1,200 | 2,210 | 2,722 | 8.4 |
| Rhode Island | 1,354 | 1,744 | 2,079 | 6.4 |
| Maine | 800 | 981 | 1,108 | 3.4 |
| Illinois | 305 | 595 | 762 | 2.3 |
| New Hampshire | 561 | 639 | 708 | 2.2 |
| Pennsylvania | 299 | 538 | 639 | 2.0 |
| Vermont | 389 | 411 | 480 | 1.5 |
| California | 426 | 427 | 470 | 1.4 |
| Maryland | 394 | 357 | 443 | 1.4 |
| North Carolina | 238 | 268 | 312 | 1.0 |
| Minnesota | 209 | 221 | 302 | .9 |
| Other States | 2,703 | 3,360 | 4,121 | 12.6 |
| Total United States | 21,526 | 27,292 | 32,580 | 100.0 |

[1] Figures for 1938 by States not yet available.

In recent years, as the demand for range oil has expanded rapidly, some No. 1 fuel oil has been sold for range fuel, replacing kerosene. In 1937, the fuel oil delivered for range fuel was reported as a separate item for the first time, and final figures show range-oil sales of 32,580,000 barrels, comprising 30,099,000 barrels of kerosene and 2,481,000 barrels of No. 1 fuel oil. Range-oil sales were 27,292,000 barrels in 1936, and it is estimated that about 2,000,000 barrels of the total was No. 1 fuel oil and the balance kerosene.

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*Sales of kerosene in the United States in 1937, by regions, States, and uses*

[Thousands of barrels]

| Region and State | Sold as range oil | Tractor fuel | All other uses | Total |
|---|---|---|---|---|
| Pacific Coast: [1] | | | | |
| Washington | 75 | | 15 | 90 |
| Oregon | 58 | | 6 | 64 |
| California | 470 | | 900 | 1,370 |
| Arizona | 37 | | 38 | 75 |
| Nevada | 15 | | | 15 |
| Rocky Mountain: | | | | |
| Idaho | 4 | 14 | 8 | 26 |
| Montana | 4 | 57 | 45 | 106 |
| Wyoming | 2 | 17 | 17 | 36 |
| Utah | 21 | 8 | 10 | 39 |
| Colorado | 17 | 73 | 47 | 137 |
| New Mexico | 17 | 25 | 44 | 86 |
| North Central: | | | | |
| North Dakota | 28 | 164 | 33 | 225 |
| South Dakota | 61 | 147 | 77 | 285 |
| Minnesota | 111 | 264 | 478 | 853 |
| Nebraska | 93 | 252 | 114 | 459 |
| Iowa | 101 | 285 | 686 | 1,072 |
| Wisconsin | 124 | 207 | 534 | 865 |
| Illinois | 465 | 347 | 1,553 | 2,365 |
| Indiana | 75 | 136 | 1,054 | 1,265 |
| Michigan | 141 | 129 | 692 | 962 |
| Ohio | 224 | 169 | 753 | 1,146 |
| Kentucky | 19 | 28 | 441 | 488 |
| Tennessee | 106 | 96 | 461 | 663 |
| South Central: | | | | |
| Missouri | 232 | 154 | 705 | 1,091 |
| Kansas | 181 | 280 | 235 | 696 |
| Texas | 206 | 378 | 1,265 | 1,849 |
| Oklahoma | 104 | 154 | 531 | 789 |
| Arkansas | 183 | 69 | 455 | 707 |
| Louisiana | 203 | 46 | 629 | 878 |
| Mississippi | 80 | 92 | 312 | 484 |
| Alabama | 67 | 37 | 456 | 560 |
| New England: | | | | |
| Maine | 1,014 | 5 | 68 | 1,087 |
| New Hampshire | 703 | | 54 | 757 |
| Vermont | 474 | 1 | 41 | 516 |
| Massachusetts | 9,369 | 14 | 319 | 9,702 |
| Rhode Island | 2,036 | | 100 | 2,136 |
| Connecticut | 2,858 | 5 | 210 | 3,073 |
| Middle Atlantic: | | | | |
| New York | 5,417 | 125 | 1,117 | 6,659 |
| New Jersey | 2,526 | 35 | 1,261 | 3,822 |
| Pennsylvania | 562 | 127 | 1,294 | 1,983 |
| Delaware | 76 | 4 | 22 | 102 |
| Maryland | 439 | 27 | 488 | 954 |
| District of Columbia | 49 | 3 | 84 | 136 |
| South Atlantic: | | | | |
| Virginia | 212 | 15 | 532 | 759 |
| West Virginia | 41 | 8 | 149 | 198 |
| North Carolina | 308 | 75 | 634 | 1,017 |
| South Carolina | 65 | 32 | 426 | 523 |
| Georgia | 191 | 52 | 390 | 633 |
| Florida | 235 | 95 | 418 | 748 |
| Total United States | 30,099 | 4,251 | 20,201 | 54,551 |

[1] Estimated.

An upward trend in representative kerosene prices evidenced in recent years continued into 1938. There was, however, only a moderate advance in the Oklahoma refinery price, which averaged 4.19 cents per gallon in 1938 compared with 4.17 cents per gallon in 1937 and 3.69 cents per gallon in 1936. The average monthly quotations show high levels of 4.31 cents per gallon for both January and July and a low price of 4.04 cents per gallon in October, followed by an advance to an average of 4.09 cents per gallon for December.

The increase in the tank-wagon price, represented by quotations at Chicago, was more pronounced, as the average advanced from

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10.04 cents per gallon in 1937 to 10.31 cents per gallon in 1938. A tank-wagon price of 10.2 cents per gallon ruled until late in March of 1938, when the quotation was raised to 10.5 cents per gallon to cover a 10-percent freight-rate increase in that marketing area. This higher price held until October, when the quotation dropped to 10 cents per gallon, where it remained until the end of the year.

## FUEL OILS[2]

The domestic demand for light or distillate fuel oils used principally for heating purposes remained at the same level in 1938 as in 1937; due largely to the decline in industrial consumption, however, the requirements for residual fuel oils fell sharply in 1938 compared with the record deliveries in 1937. Exports of fuel oils continued to expand in 1938 and established a new all-time record. The production of distillate fuel oils increased in 1938 over 1937; but the new supply of residual fuel oils, as measured by production, crude oil transferred to the fuel-oil account, and imports, reflecting the contracted demand for industrial fuel in 1938, declined sharply. The increase in fuel-oil stocks in 1938 was double the quantity added in 1937.

Domestic deliveries of fuel oils dropped from a record of 442,355,000 barrels in 1937 to 409,214,000 in 1938. The domestic demand for distillate fuel oils held in 1938, notwithstanding unfavorable economic conditions, because of heating-oil requirements and deliveries totaled 116,564,000 barrels or about the same quantity as in 1937. The inactive demand for industrial fuel caused the market for residual fuel oils to slump sharply in 1938; consequently, domestic requirements of 292,650,000 barrels were lower by 10 percent than the 1937 total of 325,514,000 barrels.

*Salient statistics of fuel oils in the United States, 1937–38*

[Thousands of barrels]

| | 1937 | | | 1938[1] | | |
|---|---|---|---|---|---|---|
| | Gas oil and distillate fuel oils | Residual fuel oils | Total | Gas oil and distillate fuel oils | Residual fuel oils | Total |
| Stocks at beginning of year | 22,813 | 84,236 | 107,049 | 22,566 | [3] 81,507 | 104,073 |
| Production | 146,706 | 312,064 | [3] 458,770 | 151,774 | 294,972 | [3] 446,746 |
| Transfers in California from crude oil to residual fuel oil | ---------- | 17,423 | 17,423 | ---------- | 10,660 | 10,660 |
| Imports: | | | | | | |
| Bonded | 1 | 19,613 | 19,614 | ---------- | 18,081 | 18,081 |
| Duty paid | 16 | 2,501 | 2,517 | ---------- | 2,904 | 2,904 |
| Exports | 30,129 | 15,304 | 45,433 | 29,903 | 17,728 | 47,631 |
| Stocks at end of year | 22,566 | 95,019 | 117,585 | 27,873 | 97,746 | 125,619 |
| Indicated domestic demand: | | | | | | |
| Class I railroads, purchases [4] | (5) | (5) | 69,292 | (5) | (5) | 57,955 |
| Public-utility power plants [6] | (5) | (5) | 14,143 | (5) | (5) | 13,039 |
| Bunker oil, foreign trade | (5) | (5) | 36,129 | (5) | (5) | 33,983 |
| All other demands | (5) | (5) | 322,791 | (5) | (5) | 304,237 |
| | 116,841 | 325,514 | 442,355 | 116,564 | 292,650 | 409,214 |

[1] Subject to revision.
[2] New basis.
[3] Includes production by cracking: 1937, 235,739; 1938, 252,245.
[4] Interstate Commerce Commission; total includes Diesel fuel.
[5] Figures not available.
[6] Federal Power Commission.

[2] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

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An examination of fuel-oil deliveries in 1938 by quarters compared with 1937 reveals that the demand for distillate fuel oils declined by 3 percent in each of the first two quarters of 1938 but that in the third quarter there was a gain of 8 percent over the corresponding 1937 period. This improved market did not hold, however, and the deliveries in the closing 3 months of 1938 were slightly below the requirements in the same quarter of 1937. Deliveries of residual fuel oils show serious losses for most of 1938 compared with 1937. This decline dipped to 17 percent in the second quarter of 1938 but was less marked thereafter, and the year closed with a 3-percent gain in the fourth quarter of 1938 compared with the final quarter of 1937.

The sharp decline in the demand for residual fuel oils in 1938 may be ascribed partly to the smaller purchases by Class I railroads reported by the Interstate Commerce Commission. The railroads, important users of heavy fuel oils, bought 57,955,000 barrels of fuel oils (including Diesel fuel) in 1938, or 16 percent less than the 69,292,000 barrels required in 1937. The Bureau of Foreign and Domestic Commerce, United States Department of Commerce, reports that vessels engaged in foreign trade loaded 33,983,000 barrels of bunker oil in 1938, 6 percent less than the 36,129,000 barrels loaded in 1937. Fuel-oil purchases by public-utility power plants compiled by the Federal Power Commission were 13,039,000 barrels in 1938—8 percent below the 1937 total of 14,143,000 barrels. If the present known items covering railroad, foreign bunker, and public-utility power-plant purchases of fuel oils in 1938 are subtracted from the indicated domestic demand for fuel oils in 1938, it is found that the remaining quantity available for all other uses, such as coastwise bunkers, industrial fuel, heating of buildings, Government requirements, and oil-company consumption in connection with petroleum production and refining, is 304,237,000 barrels for 1938 compared with 322,791,000 barrels for 1937. It is believed that the Bureau's annual fuel-oil survey for 1938 when completed will reveal that the larger portion of this loss is confined to the quantity used by smelters, mines, and manufacturing plants, due to their retarded operations in that year.

Figure 11 illustrates the trend in fuel-oil sales by principal uses, 1926–37. The sales include all grades of light and heavy fuel oils, as well as kerosene sold as range oil.

*Sales of gas oil, fuel oil,[1] and range oil, 1933–37, by uses [2]*

[Thousands of barrels]

| Use | 1933 [3] | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Gas oil and fuel oil: | | | | | |
| Railroads | 48,305 | 52,581 | 55,651 | 61,727 | 69,458 |
| Ships' bunkers (including tankers) | 70,445 | 69,262 | 74,581 | 80,324 | 84,990 |
| Gas and electric power plants | 22,507 | 23,143 | 23,647 | 26,799 | 26,510 |
| Smelters and mines | 2,538 | 2,682 | 2,448 | 3,768 | 75,298 |
| Manufacturing industries | 48,962 | 54,260 | 61,128 | 67,558 | |
| Heating oils | 50,140 | 60,822 | 76,853 | 99,257 | 116,583 |
| U. S. Navy, Army transports, etc | 8,000 | 7,914 | 10,428 | 9,241 | 9,135 |
| Oil-company fuel | 46,200 | 47,404 | 48,116 | 46,021 | 42,924 |
| Miscellaneous uses | 11,250 | 12,253 | 13,133 | 13,714 | 14,424 |
| Total United States | 308,347 | 330,321 | 365,985 | 408,409 | 439,322 |
| Exports and shipments to noncontiguous Territories | 20,563 | 28,605 | 28,948 | 34,883 | 45,433 |
| | 328,910 | 358,926 | 394,933 | 443,292 | 484,755 |
| Range oil | 10,269 | 15,756 | 21,526 | 27,292 | 32,580 |

[1] Includes some crude oil burned as fuel.
[2] Figures for 1938 not yet available.
[3] Partly estimated.

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Exports of fuel oils, including shipments to noncontiguous Territories of the United States, increased from 45,433,000 barrels in 1937 to 47,631,000 in 1938. The upward trend in fuel-oil overseas trade, which began in 1933, continued into 1938, when the domestic demand declined; in fact, the 1938 export total of 47,631,000 barrels is an all-time record, surpassing the former record attained in 1927 by a quarter of million barrels. The gain in exports in 1938 was limited to the heavy or residual grades, which increased from 15,304,000 barrels in 1937 to 17,728,000 in 1938. Exports of distillate fuel oils

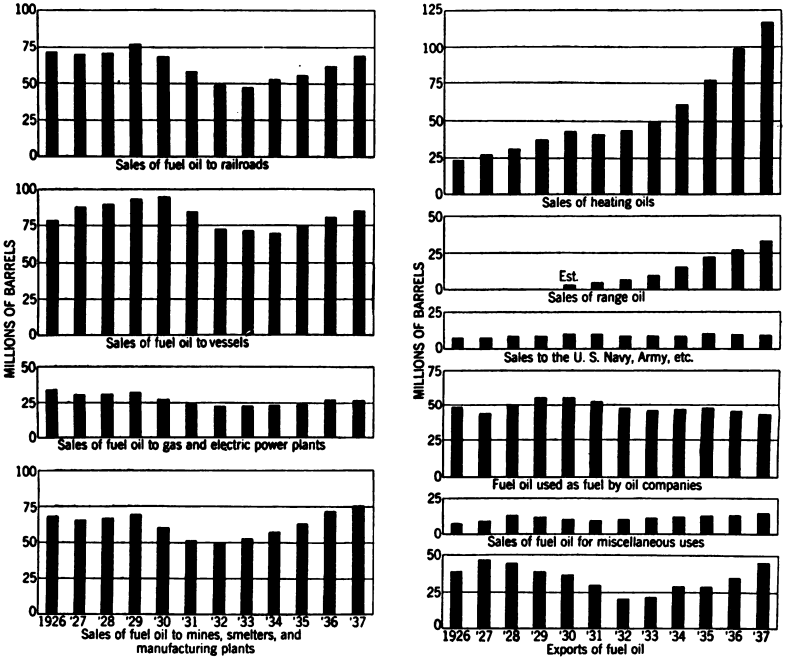
MILLIONS OF BARRELS
Sales of fuel oil to railroads
Sales of fuel oil to vessels
Sales of fuel oil to gas and electric power plants
Sales of fuel oil to mines, smelters, and manufacturing plants
Sales of heating oils
Est.
Sales of range oil
Sales to the U. S. Navy, Army, etc.
Fuel oil used as fuel by oil companies
Sales of fuel oil for miscellaneous uses
Exports of fuel oil
1926 '27 '28 '29 '30 '31 '32 '33 '34 '35 '36 '37

FIGURE 11.—Sales of fuel oils and range oil, 1926–37, by uses.

totaling 29,903,000 barrels in 1938 are approximately 1 percent under the 1937 quantity (30,129,000 barrels).

Germany and the United Kingdom increased their purchases of American distillate fuel oils in 1938 over 1937, while other important buyers, such as Japan, Netherland West Indies, Belgium, and Sweden, required less in 1938 than in 1937. The light fuel-oil trade with Japan totaled 5,297,000 barrels in 1938, a quantity about a million barrels below 1937 requirements.

Smaller exports of residual fuel oils to Japan, Chile, and Mexico in 1938 compared with 1937 were more than offset by increased shipments in 1938 to a number of countries, including Netherlands, United Kingdom, Italy, Spain, Canada, Cuba, Panama, and the Philippines. Residual fuel-oil exports to Japan decreased from 4,045,000 barrels in 1937 to 3,030,000 in 1938; however, this loss was more than counterbalanced by a gain in heavy fuel-oil shipments to Cuba, which increased from 247,000 barrels in 1937 to 1,356,000 in 1938. Further information on exports is given in the section entitled "United States Trade."

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*Sales of gas oil and fuel oils[1] in the United States, 1933–37, by regions and States[2]*

[Thousands of barrels]

| Region and State | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Pacific Coast: | | | | | |
| Washington | 8,312 | 8,485 | 8,976 | 9,331 | 11,352 |
| Oregon | 5,430 | 6,079 | 7,773 | 9,918 | 10,879 |
| California | 59,893 | 63,801 | 66,627 | 65,895 | 70,952 |
| Arizona | 448 | 729 | 2,545 | 2,585 | 3,994 |
| Nevada | 522 | 664 | 2,182 | 2,791 | 3,790 |
| Rocky Mountain: | | | | | |
| Idaho | 67 | 82 | 140 | 223 | 516 |
| Montana | 1,098 | 1,221 | 1,676 | 1,652 | 1,797 |
| Wyoming | 1,234 | 1,264 | 1,418 | 1,549 | 1,794 |
| Utah | 203 | 254 | 260 | 404 | 501 |
| Colorado | 371 | 400 | 464 | 581 | 623 |
| New Mexico | 468 | 753 | 835 | 715 | 558 |
| North Central: | | | | | |
| North Dakota | 183 | 199 | 269 | 294 | 375 |
| South Dakota | 294 | 353 | 474 | 536 | 599 |
| Minnesota | 2,697 | 2,796 | 2,986 | 4,093 | 4,993 |
| Nebraska | 1,125 | 1,152 | 1,315 | 1,743 | 1,935 |
| Iowa | 1,073 | 1,032 | 1,378 | 1,873 | 2,171 |
| Wisconsin | 2,017 | 2,415 | 2,992 | 4,022 | 4,690 |
| Illinois | 11,861 | 13,206 | 15,037 | 18,351 | 20,667 |
| Indiana | 6,264 | 6,199 | 6,935 | 7,450 | 7,876 |
| Michigan | 5,723 | 7,631 | 8,634 | 9,000 | 9,727 |
| Ohio | 5,381 | 5,393 | 5,826 | 7,173 | 8,024 |
| Kentucky | 640 | 749 | 815 | 799 | 972 |
| Tennessee | 390 | 500 | 328 | 387 | 579 |
| South Central: | | | | | |
| Missouri | 5,098 | 5,456 | 6,583 | 7,605 | 8,918 |
| Kansas | 5,924 | 6,693 | 7,394 | 7,764 | 7,331 |
| Texas | 38,696 | 38,368 | 39,382 | 41,841 | 43,195 |
| Oklahoma | 9,698 | 9,836 | 9,581 | 9,461 | 9,075 |
| Arkansas | 2,276 | 2,345 | 2,544 | 2,876 | 2,655 |
| Louisiana | 8,663 | 8,585 | 10,481 | 11,614 | 12,345 |
| Mississippi | 231 | 265 | 476 | 593 | 794 |
| Alabama | 1,127 | 1,174 | 1,294 | 1,545 | 1,877 |
| New England: | | | | | |
| Maine | 1,829 | 1,487 | 1,756 | 2,328 | 2,396 |
| New Hampshire | 734 | 885 | 1,176 | 1,363 | 1,508 |
| Vermont | 296 | 353 | 393 | 458 | 560 |
| Massachusetts | 12,786 | 14,394 | 17,187 | 18,829 | 21,522 |
| Rhode Island | 5,591 | 6,412 | 6,591 | 6,894 | 7,240 |
| Connecticut | 3,692 | 4,862 | 5,742 | 7,047 | 7,708 |
| Middle Atlantic: | | | | | |
| New York | 28,097 | 30,367 | 36,087 | 42,215 | 43,028 |
| New Jersey | 30,193 | 30,646 | 32,554 | 41,458 | 44,036 |
| Pennsylvania | 19,751 | 21,871 | 23,452 | 26,098 | 26,243 |
| Delaware | 765 | 865 | 914 | 1,335 | 1,659 |
| Maryland | 6,217 | 7,053 | 7,715 | 8,423 | 9,545 |
| District of Columbia | 1,141 | 1,190 | 1,509 | 1,911 | 2,105 |
| South Atlantic: | | | | | |
| Virginia | 1,369 | 1,808 | 2,575 | 3,420 | 3,634 |
| West Virginia | 613 | 576 | 919 | 840 | 807 |
| North Carolina | 253 | 334 | 402 | 504 | 587 |
| South Carolina | 367 | 549 | 509 | 591 | 640 |
| Georgia | 1,211 | 1,280 | 1,497 | 1,744 | 1,776 |
| Florida | 6,035 | 7,310 | 7,387 | 8,287 | 8,774 |
| Total United States | 308,347 | 330,321 | 365,985 | 408,409 | 439,322 |

[1] Includes some crude oil burned as fuel.
[2] Figures for 1938 not yet available.

Crude oil runs to stills in 1938 totaling 1,165,015,000 barrels represents a decline of less than 2 percent compared with the 1937 throughput of 1,183,440,000 barrels; however, the production of fuel oils changed by nearly 3 percent, decreasing from 458,770,000 barrels in 1937 to 446,746,000 in 1938. The lower yield of fuel oils in 1938 represents a net loss, as the distillate fuel-oil output increased—probably in anticipation of an expanding demand for heating oils—by nearly 4 percent, or from 146,706,000 barrels in 1937 to 151,774,000 in 1938, while the production of residual fuel oils was reduced, because of slackened market demand, by over 5 percent, totaling 294,972,000

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barrels in 1938 compared with 312,064,000 in 1937. The increased production of light fuel oils and the cut in the heavy fuel-oil output in 1938 were brought about largely by varying the average yield factors, which for the distillate grades increased from 12.4 percent in 1937 to 13.0 in 1938, whereas the average yield for residual fuel oils was reduced from 26.4 percent in 1937 to 25.3 in 1938.

*Comparative analyses of statistics for gas oil and distillate fuel oils in the United States, 1937–38, by months and districts*

| | Production (thousands of barrels) | | Yield (percent) | | Domestic demand (thousands of barrels) | | Stocks (thousands of barrels) | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] |
| By months: | | | | | | | | |
| January | 13,319 | 13,876 | 14.1 | 14.2 | [2] 14,847 | 12,642 | 19,088 | 21,543 |
| February | 11,206 | 12,144 | 13.2 | 13.8 | [2] 10,550 | 11,651 | 18,211 | 19,885 |
| March | 11,005 | 12,294 | 11.7 | 12.8 | [2] 10,532 | 10,487 | 16,724 | 18,882 |
| April | 10,674 | 11,577 | 11.4 | 12.1 | [2] 7,999 | 7,800 | 16,889 | 19,972 |
| May | 11,158 | 12,160 | 11.1 | 12.2 | [2] 6,805 | 7,050 | 18,451 | 22,385 |
| June | 11,088 | 10,784 | 11.2 | 11.5 | [2] 6,249 | 5,490 | 20,657 | 24,699 |
| July | 12,654 | 12,688 | 12.1 | 12.7 | 6,584 | 7,863 | 23,637 | 26,620 |
| August | 12,558 | 12,691 | 11.9 | 12.5 | 7,197 | 7,737 | 25,952 | 28,841 |
| September | 12,681 | 13,074 | 12.3 | 13.5 | 8,672 | 8,627 | 27,020 | 30,860 |
| October | 13,585 | 13,820 | 12.9 | 13.7 | [2] 9,939 | 10,089 | 28,101 | 33,017 |
| November | 13,215 | 12,793 | 13.3 | 13.1 | 11,639 | 11,472 | 26,852 | 32,069 |
| December | 13,563 | 13,873 | 13.8 | 14.2 | 15,828 | 15,656 | 22,566 | 27,873 |
| Total United States | 146,706 | 151,774 | 12.4 | 13.0 | [2] 116,841 | 116,564 | 22,566 | 27,873 |
| By districts: | | | | | | | | |
| East Coast | 30,020 | 28,559 | 15.2 | 15.8 | | | 5,090 | 5,821 |
| Appalachian | 2,756 | 2,446 | 6.8 | 6.2 | | | 256 | 270 |
| Indiana, Illinois, Kentucky, etc. | 17,033 | 17,397 | 10.4 | 10.7 | | | 2,538 | 3,427 |
| Oklahoma, Kansas, and Missouri | 11,434 | 11,163 | 9.4 | 10.0 | | | 1,344 | 1,443 |
| Texas Inland | 5,423 | 4,217 | 7.2 | 6.3 | [3] | [3] | 285 | 395 |
| Texas Gulf Coast | 39,385 | 47,529 | 14.0 | 15.4 | | | 5,048 | 5,462 |
| Louisiana Gulf Coast | 7,800 | 7,450 | 15.4 | 15.9 | | | 910 | 1,043 |
| Arkansas and Louisiana Inland | 2,428 | 2,341 | 9.7 | 9.7 | | | 111 | 268 |
| Rocky Mountain | 1,462 | 1,689 | 6.3 | 6.8 | | | 204 | 271 |
| California | 28,965 | 28,983 | 14.3 | 14.5 | | | 6,780 | 9,473 |
| Total United States | 146,706 | 151,774 | 12.4 | 13.0 | [2] 116,841 | 116,564 | 22,566 | 27,873 |

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

The Texas Gulf Coast was the only important refining area to show a gain in the production of fuel oils in 1938, the output increasing from 112,608,000 barrels in 1937 to 121,303,000 in 1938. There was, however, little change in that area in the yield of residual fuel oils, which amounted to about 73,000,000 barrels for both 1937 and 1938, while the distillate grades increased from 39,385,000 barrels in 1937 to 47,529,000 in 1938. California refineries, the chief source of residual fuel oils, are credited with a fuel-oil production of 115,024,000 barrels in 1938 compared with 116,665,000 barrels in 1937. Both light and heavy fuel oils were produced in reduced quantities in the East Coast region in 1938, the total yield declining from 85,294,000 barrels in 1937 to 79,281,000 in 1938. The Indiana-Illinois area produced 40,716,000 barrels of fuel oils in 1938, 1,300,000 barrels less than the 1937 output. In that territory a small gain in the production of distillate fuel oils was offset by a decline in the yield of residual fuel oils from 24,953,000 barrels in 1937 to 23,319,000 in 1938.

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In the California area some crude oil, below standard for refining purposes, is transferred each year to the fuel-oil account. These transfers increased steadily as the demand for fuel oils developed, reaching a peak of 17,423,000 barrels in 1937 but dropping to 10,660,000 barrels in 1938. This decrease in the transfer of crude oil to the fuel-oil supply in 1938 apparently is associated with the lower demand for heavy fuel oils, as the non-gasoline-bearing crude available for fuel oil use was several times the quantity actually shifted to the fuel-oil inventory. Furthermore, the price of crude oil in California remained virtually unchanged during 1938 compared with a drop from $1.00 to $0.80 per barrel for heavy fuel oil, so that there was less incentive to make transfers from crude to the fuel-oil account.

The supply of fuel oils was augmented by imports in 1938 of 20,985,000 barrels compared with 22,131,000 barrels in 1937. Nearly all this fuel oil originated in the Netherland West Indies, and the larger share was entered at the Port of New York. Most of the fuel oil imported is received in bond and is released later for the bunkering of vessels, without payment of import duty. There were no imports of distillate fuel oils in 1938. Imports of residual fuel oils in 1937 and 1938 were classified as follows—18,081,000 barrels received in bond in 1938 compared with 19,613,000 in 1937, and duty paid for domestic use on 2,904,000 barrels in 1938 and 2,501,000 in 1937.

Curtailed domestic demand caused fuel-oil stocks to increase heavily in 1938, when over 21,500,000 barrels were added to storage compared with a gain in stocks of 10,500,000 barrels in 1937. As of January 1, 1938, stocks of unmixed heavy crude in California were separated from other fuel-oil stocks. On the new basis, the gain in residual fuel-oil stocks for the United States as a whole in 1938 was 16,239,000 barrels compared with a gain of 10,783,000 barrels in 1937. Stocks of distillate fuel oils increased by 5,307,000 barrels in 1938 in contrast to a decline of 247,000 barrels in 1937.

The gain in 1938 of 5,300,000 barrels in distillate fuel-oil stocks was divided about equally between the California area, with an increase of 2,700,000 barrels, and the rest of the country, where 2,600,000 barrels were added to storage. The more important changes in light fuel-oil stocks in 1938, outside of California, occurred in the Indiana-Illinois refining area, where approximately 900,000 barrels were added; the East Coast district, with a gain of about 700,000 barrels; and the Texas Gulf Coast district, with an increase of 400,000 barrels.

The major stock increase for 1938 is for the California area, where approximately 16,600,000 barrels of residual fuel oils were added to storage during the year, largely as a result of lower domestic and export demand. Heavy fuel-oil inventories in refining areas other than California made a net decline of about 400,000 barrels in 1938. There was a shrinkage of 1,400,000 barrels in the volume of residual fuel oils held in the Louisiana Gulf Coast district and smaller stock losses for the Appalachian and Indiana-Illinois areas. All other districts east of California showed gains in heavy fuel-oil stocks for 1938; the larger increase was in the Oklahoma-Kansas-Missouri group of States, where over 600,000 barrels of residual fuel oils were added to storage.

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*Comparative analyses of statistics for residual fuel oils in the United States, 1937–38, by months and districts*

| | Production (thousands of barrels) | | Yield (percent) | | Transfers (thousands of barrels) | | Domestic demand (thousands of barrels) | | Stocks (thousands of barrels) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1937 [1] | 1938 [2] | 1937 | 1938 [2] | 1937 | 1938 [2] | 1937 [1] | 1938 [2] | 1937 | 1938 [2] |
| By months: | | | | | | | | | | |
| January | 25,623 | 26,204 | [1] 27.2 | 26.8 | 1,671 | 1,230 | 28,116 | 25,844 | [1] 83,406 | [3] 83,902 |
| February | 22,302 | 23,866 | 26.2 | 27.1 | 1,222 | 1,285 | 27,511 | 23,627 | 80,571 | 85,753 |
| March | 25,191 | 25,328 | [1] 26.7 | 26.4 | 1,369 | 1,047 | 29,789 | 25,696 | 78,435 | 86,920 |
| April | 24,100 | 24,833 | [1] 25.8 | 26.0 | 1,699 | 843 | 27,874 | 22,279 | 77,318 | 90,893 |
| May | 26,587 | 24,392 | [1] 26.5 | 24.6 | 1,503 | 846 | 26,530 | 22,447 | 79,158 | 93,753 |
| June | 26,033 | 22,761 | [1] 26.2 | 24.2 | 1,459 | 815 | 26,250 | 22,278 | 81,224 | 95,690 |
| July | 26,958 | 23,547 | 25.7 | 23.6 | 1,191 | 830 | 25,890 | 20,548 | 84,154 | 99,363 |
| August | 26,026 | 24,232 | [1] 24.7 | 23.9 | 1,762 | 662 | 26,391 | 23,775 | 86,420 | 100,431 |
| September | 27,094 | 24,552 | [1] 26.2 | 25.3 | 845 | 666 | 26,408 | 23,082 | 89,007 | 102,831 |
| October | 28,425 | 25,487 | [1] 27.1 | 25.3 | 1,468 | 882 | 26,913 | 25,666 | 92,182 | 103,423 |
| November | 26,687 | 24,573 | [1] 26.8 | 25.1 | 1,392 | 894 | 26,180 | 27,621 | 93,225 | 101,569 |
| December | 27,038 | 25,197 | [1] 27.5 | 25.7 | 1,842 | 660 | 27,662 | 29,787 | 95,019 | 97,746 |
| Total United States | 312,064 | 294,972 | [1] 26.4 | 25.3 | 17,423 | 10,660 | 325,514 | 292,650 | 95,019 | 97,746 |
| By districts: | | | | | | | | | | |
| East Coast | 55,274 | 50,722 | [1] 27.9 | 28.1 | ------ | ------ | (4) | (4) | 7,421 | 7,413 |
| Appalachian | 4,315 | 4,725 | [1] 10.7 | 12.1 | ------ | ------ | | | 860 | 568 |
| Indiana, Illinois, Kentucky, etc. | 24,953 | 23,319 | [1] 15.2 | 14.3 | ------ | ------ | | | 4,309 | 4,025 |
| Oklahoma, Kansas, and Missouri | 21,819 | 19,101 | [1] 18.0 | 17.2 | ------ | ------ | | | 2,871 | 3,527 |
| Texas Inland | 20,914 | 15,871 | [1] 27.7 | 23.7 | ------ | ------ | | | 1,681 | 2,113 |
| Texas Gulf Coast | 73,223 | 73,774 | 26.0 | 24.0 | ------ | ------ | | | 6,775 | 6,978 |
| Louisiana Gulf Coast | 13,212 | 10,806 | [1] 26.0 | 23.0 | ------ | ------ | | | 2,581 | 1,162 |
| Arkansas and Louisiana Inland | 6,215 | 5,697 | [1] 24.9 | 23.6 | ------ | ------ | | | 324 | 586 |
| Rocky Mountain | 4,439 | 4,916 | [1] 19.0 | 19.8 | ------ | ------ | | | 541 | 619 |
| California | 87,700 | 86,041 | [1] 43.2 | 42.9 | 17,423 | 10,660 | | | 67,656 | 70,755 |
| Total United States | 312,064 | 294,972 | [1] 26.4 | 25.3 | 17,423 | 10,660 | 325,514 | 292,650 | 95,019 | 97,746 |

[1] Revised figures.
[2] Subject to revision.
[3] Stocks on new basis; corresponding United States total for January 1, 1938, 81,507, and for California, 54,144.
[4] Figures not available.

Monthly refinery reports reveal a shipment of 59,000 barrels of residual fuel oil from California to the East coast in October, 1938, which may be significant, as it is the first heavy fuel-oil movement in that direction since November 1934. Similar shipments appear for November and December 1938, making a total of 338,000 barrels for the year. The market price of heavy fuel oil on the Pacific coast plus tanker rates do not apparently justify such movement at this time; however, the need for additional outlets for California heavy fuel oil and possible anticipation of a rising demand for industrial fuel oils in the eastern area, where excessive stocks are not a factor, may all be underlying reasons for revival of this trade. The shipment of distillate fuel oils from California to the East dropped from 726,000 barrels in 1937 to 321,000 in 1938.

The movement of distillate fuel oils from the Gulf coast to eastern ports increased from 27,452,000 barrels in 1937 to 29,187,000 in 1938, while the transfer of residual oils changed but slightly, totaling 56,987,000 barrels in 1938 and 56,891,000 in 1937.

The price of fuel oils showed a marked downward trend in 1938 due more to an inactive market demand than to the influence of changing crude-oil prices, which were fairly well maintained at an average of $1.15 per barrel in 1938 compared with $1.18 per barrel in 1937. A review of refinery and market prices in all sections of the country discloses, with few exceptions, lower quotations for fuel oils at the end of 1938 than at the close of 1937.

Lower tanker rates forced a reduction in the New York price of Bunker C fuel oil on March 11, 1938, from $1.25 to $1.15 per barrel

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and a relative decline in the quotation at Gulf coast points to $0.85 per barrel. Bunker C fuel oil in the Pacific market dropped from a February average of $0.99 per barrel to a March average of $0.96 per barrel. A further decline of 10 cents per barrel in the price of Bunker C at Atlantic coast points became effective April 5, 1938, making the New York quotation $1.05 per barrel. Still lower tanker rates and a competitive market due to reduced industrial demand were given as the reasons for the price cut. At this time Bunker C was reduced by only 5 cents per barrel to $0.80 on the Gulf coast, while Pacific coast prices showed no reaction until early May, when the average quotation declined from $0.95 to $.89 per barrel. There was a general reduction in the price of light and heavy fuel oils along the Atlantic seaboard during the week ending June 25, 1938, due to a slackened demand and mounting stocks. Bunker C fuel oil at New York was dropped from $1.05 to $0.95 per barrel, and this price held until the end of the year. The Gulf coast quotation, reflecting this general reduction, declined by 5 cents to $0.75 per barrel; however, there was no general change in the Bunker C price in the California marketing area until early August, when the price dropped to $0.80 per barrel for the balance of 1938.

*Monthly average prices of kerosene and fuel oil in the United States, 1937–38* [1]

| | January | February | March | April | May | June | July | August | September | October | November | December | Average for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1937** | | | | | | | | | | | | | |
| 41°–43° gravity w. w. kerosene at refineries, Oklahoma cents per gallon | 3.89 | 4.22 | 4.25 | 4.27 | 4.30 | 4.26 | 4.16 | 4.13 | 4.13 | 4.13 | 4.13 | 4.16 | 4.17 |
| Kerosene, tank-wagon at Chicago cents per gallon | 9.57 | 9.80 | 10.10 | 10.10 | 10.10 | 10.10 | 10.10 | 10.10 | 10.10 | 10.10 | 10.15 | 10.20 | 10.04 |
| No. 1 straw distillate at refineries, Oklahoma cents per gallon | 3.66 | 3.97 | 3.93 | 3.81 | 3.80 | 3.75 | 3.75 | 3.76 | 3.81 | 3.88 | 3.89 | 4.00 | 3.83 |
| 28°–30° gravity zero distillate at refineries, Oklahoma cents per gallon | 3.47 | 3.56 | 3.50 | 3.44 | 3.44 | 3.40 | 3.25 | 3.26 | 3.34 | 3.56 | 3.58 | 3.63 | 3.45 |
| Bunker C for ships: | | | | | | | | | | | | | |
| New York dollars per barrel | 1.15 | 1.20 | 1.20 | 1.20 | 1.28 | 1.35 | 1.35 | 1.35 | 1.35 | 1.35 | 1.27 | 1.25 | 1.27 |
| Gulf coast do | .95 | 1.00 | 1.00 | 1.00 | 1.03 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | .97 | .95 | 1.01 |
| California do | .93 | .94 | .93 | .93 | .95 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.06 | 1.02 |
| Diesel oil for ships: | | | | | | | | | | | | | |
| New York dollars per barrel | 1.80 | 1.85 | 1.85 | 1.85 | 2.10 | 2.18 | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 | 2.07 |
| Gulf coast do | 1.58 | 1.65 | 1.65 | 1.65 | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 | 1.81 |
| California do | 1.09 | 1.26 | 1.30 | 1.30 | 1.33 | 1.55 | 1.64 | 1.64 | 1.64 | 1.64 | 1.64 | 1.64 | 1.47 |
| **1938** | | | | | | | | | | | | | |
| 41°–43° gravity w. w. kerosene at refineries, Oklahoma cents per gallon | 4.31 | 4.28 | 4.22 | 4.19 | 4.19 | 4.23 | 4.31 | 4.20 | 4.09 | 4.04 | 4.06 | 4.09 | 4.19 |
| Kerosene, tank-wagon at Chicago cents per gallon | 10.20 | 10.20 | 10.27 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.10 | 10.00 | 10.00 | 10.31 |
| No. 1 straw distillate at refineries, Oklahoma cents per gallon | 4.13 | 4.06 | 3.88 | 3.81 | (2) | (2) | (2) | (2) | (2) | 3.75 | 3.75 | 3.77 | 3.88 |
| 28°–30° gravity zero distillate at refineries, Oklahoma cents per gallon | 3.69 | 3.66 | 3.56 | 3.39 | 3.31 | 3.31 | 3.31 | 3.34 | 3.38 | 3.38 | 3.38 | 3.31 | 3.42 |
| Bunker C for ships: | | | | | | | | | | | | | |
| New York dollars per barrel | 1.25 | 1.25 | 1.18 | 1.08 | 1.05 | 1.03 | .95 | .95 | .95 | .95 | .95 | .95 | 1.04 |
| Gulf coast do | .95 | .95 | .88 | .81 | .80 | .78 | .75 | .75 | .75 | .75 | .75 | .75 | .81 |
| California do | .99 | .99 | .96 | .95 | .91 | .89 | .89 | .84 | .80 | .80 | .80 | .80 | .88 |
| Diesel oil for ships: | | | | | | | | | | | | | |
| New York dollars per barrel | 2.14 | 2.10 | 1.98 | 1.85 | 1.75 | 1.73 | 1.66 | 1.73 | 1.75 | 1.75 | 1.75 | 1.75 | 1.83 |
| Gulf coast do | 1.90 | 1.90 | 1.83 | 1.75 | 1.63 | 1.65 | 1.65 | 1.59 | 1.55 | 1.55 | 1.55 | 1.55 | 1.67 |
| California do | 1.64 | 1.64 | 1.64 | 1.64 | 1.58 | 1.54 | 1.54 | 1.54 | 1.54 | 1.54 | 1.54 | 1.45 | 1.57 |

[1] National Petroleum News.

[2] Figures not quoted.

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Retail price quotations for heating oils, as compiled by the Bureau of Labor Statistics, United States Department of Labor, exhibit the general downward trend of fuel-oil prices in 1938. The Chicago retail price for No. 2 heating oil was quoted at an average of 7.21 cents per gallon during the first half of 1938; however, by the opening of the heating season in September it had fallen to 7.08 cents per gallon. December average prices show a slight upturn to 7.15 cents per gallon for the Chicago market. The New York retail price for No. 2 heating oil dropped steadily during the year, from 7.65 cents per gallon in December 1937 to 6.60 cents per gallon in December 1938.

## LUBRICANTS

The domestic demand for lubricants declined 9 percent, from 23,323,000 barrels in 1937 to 21,248,000 in 1938. Most of the decline was in that used for industrial purposes, which dropped from 10,483,000 to 8,700,000 barrels (17 percent). The accompanying table shows estimates of the proportions of lubricating oil used for automotive and industrial purposes.

Exports of lubricants declined 14 percent, or from 10,975,000 barrels in 1937 to 9,402,000 in 1938, making a decrease of approximately 11 percent in total demand.

Production of lubricants declined from 35,321,000 to 30,826,000 barrels. The East Coast and the Texas Gulf Coast districts each produced 24.7 percent of this total. This is the largest proportion that the Texas Gulf Coast district has supplied during the past 10 years, while the figure for the East Coast district is the lowest of a 10-year downward trend. Aside from these developments, production statistics by districts show no significant changes.

*Domestic demand for lubricating oils, 1929–38*

[Thousands of barrels]

| Year | Automotive | | | | Industrial | Total demand |
|---|---|---|---|---|---|---|
| | Passenger cars | Trucks | Busses | Total | | |
| 1929 | 9,754 | 2,010 | 188 | 11,952 | 11,657 | 23,609 |
| 1930 | 9,899 | 2,004 | 213 | 12,116 | 9,473 | 21,589 |
| 1931 | 9,782 | 1,965 | 221 | 11,968 | 8,100 | 20,068 |
| 1932 | 8,780 | 1,739 | 216 | 10,735 | 5,879 | 16,614 |
| 1933 | 8,516 | 1,757 | 212 | 10,485 | 6,667 | 17,152 |
| 1934 | 8,920 | 1,920 | 227 | 11,067 | 7,417 | 18,484 |
| 1935 | 9,098 | 2,043 | 241 | 11,382 | 8,279 | 19,661 |
| 1936 | 9,721 | 2,270 | 255 | 12,246 | 10,077 | 22,323 |
| 1937 [1] | 10,115 | 2,455 | 270 | 12,840 | 10,483 | 23,323 |
| 1938 [2] | 9,924 | 2,365 | 259 | 12,548 | 8,700 | 21,248 |

[1] Revised figures.
[2] Subject to revision

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*Comparative analyses of statistics for lubricants in the United States, 1937–38, by months and districts*

| | Production (thousands of barrels) | | Yield (percent) | | Domestic demand (thousands of barrels) | | Stocks (thousands of barrels) | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] |
| By months: | | | | | | | | |
| January | 2,649 | 2,785 | 2.8 | 2.8 | [2] 1,625 | 1,471 | 6,788 | 8,006 |
| February | 2,728 | 2,468 | 3.2 | 2.8 | [2] 1,429 | 1,311 | 7,115 | 8,363 |
| March | [2] 2,873 | 2,697 | 3.0 | 2.8 | [2] 2,500 | 2,195 | 6,771 | 8,210 |
| April | 3,048 | 2,530 | 3.3 | 2.6 | 2,224 | 1,591 | 6,556 | 8,290 |
| May | 3,141 | 2,595 | 3.1 | 2.6 | [2] 2,079 | 1,730 | 6,478 | 8,255 |
| June | [2] 2,978 | 2,378 | 3.0 | 2.5 | [2] 2,028 | 1,606 | 6,447 | 8,114 |
| July | 2,980 | 2,631 | 2.8 | 2.6 | [2] 1,985 | 1,844 | 6,566 | 8,194 |
| August | 2,900 | 2,576 | 2.8 | 2.5 | [2] 1,925 | 2,002 | 6,426 | 7,969 |
| September | 2,920 | 2,615 | 2.8 | 2.7 | 1,968 | 2,127 | 6,542 | 7,605 |
| October | 3,215 | 2,632 | 3.1 | 2.6 | [2] 2,028 | 1,805 | 6,789 | 7,718 |
| November | 2,953 | 2,535 | 3.0 | 2.6 | 2,037 | 1,735 | 6,907 | 7,817 |
| December | 2,936 | 2,384 | 3.0 | 2.4 | [2] 1,495 | 1,831 | 7,512 | 7,695 |
| Total United States | 35,321 | 30,826 | 3.0 | 2.6 | [2] 23,323 | 21,248 | 7,512 | 7,695 |
| By districts: | | | | | | | | |
| East Coast | 9,360 | 7,613 | 4.7 | 4.2 | | | 2,355 | 2,230 |
| Appalachian | 6,083 | 5,763 | 15.1 | 14.7 | | | 807 | 910 |
| Indiana, Illinois, Kentucky, etc | 3,457 | 2,609 | 2.1 | 1.6 | | | 667 | 577 |
| Oklahoma, Kansas, and Missouri | 3,659 | 2,962 | 3.0 | 2.7 | | | 710 | 565 |
| Texas Inland | 229 | 213 | .3 | .3 | [3] | [3] | 85 | 64 |
| Texas Gulf Coast | 7,929 | 7,628 | 2.8 | 2.5 | | | 1,406 | 1,810 |
| Louisiana Gulf Coast | 1,246 | 1,097 | 2.5 | 2.3 | | | 150 | 192 |
| Arkansas and Louisiana Inland | 467 | 452 | 1.9 | 1.9 | | | 69 | 44 |
| Rocky Mountain | 305 | 205 | 1.3 | .8 | | | 108 | 101 |
| California | 2,586 | 2,284 | 1.3 | 1.1 | | | 1,155 | 1,202 |
| Total United States | 35,321 | 30,826 | 3.0 | 2.6 | [2] 23,323 | 21,248 | 7,512 | 7,695 |

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

Stocks of lubricants—7,695,000 barrels on December 31, 1938—were 183,000 barrels higher than on December 31, 1937. The largest gain was in the Texas Gulf Coast area, where they increased 404,000 barrels to total 1,810,000 barrels. Stocks also increased in the California, Appalachian, and Louisiana Gulf Coast areas but declined in the other districts.

Lubricating-oil prices in general did not change greatly in 1938 after their precipitous drop in 1937. A Pennsylvania neutral selling for 18.75 cents in early January slumped to 13.00 cents in June but subsequently recovered to 15.5 cents in December. Pennsylvania steam-refined cylinder stocks that sold for 7.75 cents in early January rose to 9.00 cents in the late spring and were selling at 8.00 cents at the close of the year. The price of Gulf Coast neutral oil that sold for 8.50 cents in January encountered a persistent downward trend and had drifted to 7.63 cents in December.

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There is a pronounced difference in the long-term trends in the prices of lubricating oils. The average prices in 1938 of the Oklahoma, Pennsylvania, and Gulf Coast neutrals used in the accompanying table were 94, 77, and 73 percent, respectively, of their 1930 averages, while the average prices in 1938 of Oklahoma bright stock and Pennsylvania cylinder stock were 49 and 53 percent of their 1930 averages. This is probably a result of the modern automobile requiring a lighter grade of oil than the one of a few years ago, which has changed the basic requirements for oil compounding from a major proportion of bright stocks to one of neutrals.

*Average monthly refinery prices of five selected grades of lubricating oils, 1937–38, in cents per gallon* [1]

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| Oklahoma: | | | | | | | | | | | | | |
| 200 viscosity, No. 3 color, neutral | 10.00 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.46 |
| 150–160 viscosity at 210°, bright stock, 10–25 pour test | 17.00 | 18.25 | 19.30 | 19.50 | 19.50 | 19.50 | 19.00 | 18.50 | 17.25 | 16.25 | 16.00 | 15.25 | 17.94 |
| Pennsylvania: | | | | | | | | | | | | | |
| 200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test | 23.13 | 23.25 | 24.55 | 26.00 | 27.75 | 27.35 | 25.38 | 24.80 | 24.75 | 24.25 | 21.05 | 18.75 | 24.25 |
| 600 steam-refined, cylinder stock | 13.75 | 15.25 | 17.05 | 17.69 | 17.25 | 16.85 | 14.88 | 14.30 | 13.44 | 10.22 | 8.95 | 7.88 | 13.96 |
| Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral | 8.75 | 9.25 | 9.03 | 8.88 | 8.88 | 8.88 | 8.88 | 8.88 | 8.88 | 8.88 | 8.88 | 8.50 | 8.88 |
| 1938 | | | | | | | | | | | | | |
| Oklahoma: | | | | | | | | | | | | | |
| 200 viscosity, No. 3 color, neutral | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.50 | 10.25 | 10.25 | 10.25 | 10.44 |
| 150–160 viscosity at 210°, bright stock, 10–25 pour test | 15.10 | 15.25 | 15.25 | 14.75 | 14.50 | 14.50 | 14.50 | 14.50 | 14.50 | 14.50 | 14.50 | 14.50 | 14.70 |
| Pennsylvania: | | | | | | | | | | | | | |
| 200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test | 17.25 | 17.25 | 17.25 | 16.31 | 14.40 | 13.00 | 13.00 | 14.15 | 15.50 | 16.05 | 16.00 | 15.63 | 15.48 |
| 600 steam-refined, cylinder stock | 8.25 | 8.75 | 8.88 | 9.00 | 9.00 | 9.00 | 8.44 | 8.25 | 8.25 | 8.05 | 8.00 | 8.00 | 8.49 |
| Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral | 8.50 | 8.25 | 8.19 | 8.00 | 8.00 | 7.75 | 7.75 | 7.75 | 7.75 | 7.75 | 7.69 | 7.63 | 7.92 |

[1] National Petroleum News.

## OTHER PRODUCTS

### WAX

Domestic demand for wax decreased for the second successive year from 297,288,000 pounds in 1937 to 278,060,000 in 1938. Exports also declined from 231,723,000 to 201,919,000 pounds, making the total demand for wax in 1938, 9 percent less than it was in 1937. Production slumped 17 percent to 435,400,000 pounds, imports dropped 22 percent, and stocks on December 31 fell 11 percent to 129,340,000 pounds.

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Wax prices were much weaker than is indicated by the year's average of 2.23 cents per pound compared with the 1937 average of 2.82 cents. The price per pound declined rapidly early in the year from 2.85 cents at the end of December to 1.93 cents in April, a drop of 35 percent from the high of August 1937. Subsequently it recovered to 2.40 cents and was 2.32 at the end of the year.

*Comparative analyses of statistics for wax in the United States, 1937–38, by months and districts*

[Thousands of pounds]

| | Production | | Domestic demand | | Stocks | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Crude scale | | Refined | |
| | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] |
| By months: | | | | | | | | |
| January | 41,720 | 41,720 | [2] 29,660 | 32,148 | [2] 25,435 | 104,462 | 36,355 | 41,167 |
| February | 41,720 | 34,720 | [2] 19,511 | 23,130 | [2] 76,070 | 110,562 | 36,792 | 38,261 |
| March | 41,720 | 39,760 | [2] 25,037 | 25,272 | [2] 74,246 | 112,123 | 33,857 | 38,342 |
| April | 43,680 | 31,640 | [2] 30,704 | 28,339 | [2] 71,361 | 107,903 | 31,814 | 36,723 |
| May | [2] 47,600 | 35,560 | [2] 22,830 | 25,755 | [2] 73,907 | 107,540 | 32,182 | 33,286 |
| June | 41,160 | 37,800 | [2] 25,194 | 23,660 | [2] 73,299 | 107,611 | 32,377 | 30,649 |
| July | 43,680 | 30,240 | [2] 29,601 | 20,743 | [2] 75,208 | 105,492 | 34,110 | 30,419 |
| August | 42,000 | 31,920 | [2] 23,895 | 22,619 | [2] 77,303 | 102,690 | 38,928 | 31,413 |
| September | 42,000 | 36,400 | [2] 23,448 | 19,303 | [2] 82,209 | 97,775 | 41,354 | 31,243 |
| October | 44,240 | 42,000 | [2] 23,763 | 20,163 | [2] 86,646 | 92,900 | 42,449 | 36,026 |
| November | 49,000 | 37,520 | [2] 22,022 | 19,865 | 93,197 | 93,618 | 46,670 | 38,154 |
| December | 43,120 | 36,120 | 21,623 | 17,063 | 96,915 | 90,251 | 48,077 | 39,089 |
| Total United States | [2] 521,640 | 435,400 | [2] 297,288 | 278,060 | 96,915 | 90,251 | 48,077 | 39,089 |
| By districts: | | | | | | | | |
| East Coast | 249,760 | 196,560 | | | 34,572 | 30,790 | 27,953 | 15,447 |
| Appalachian | 87,360 | 82,880 | | | 13,188 | 14,975 | 2,188 | 1,824 |
| Indiana, Illinois, Kentucky, etc. | 43,120 | 31,640 | | | 21,639 | 19,076 | 2,610 | 2,674 |
| Oklahoma, Kansas, and Missouri | 33,600 | 30,800 | (3) | (3) | 2,722 | 1,649 | 1,545 | 1,261 |
| Texas Inland | 3,360 | 1,960 | | | 144 | 260 | | |
| Texas Gulf Coast | 52,640 | 60,200 | | | 856 | 774 | 10,078 | 15,489 |
| Louisiana Gulf Coast | 28,000 | 19,600 | | | 573 | 642 | 1,882 | 1,175 |
| Arkansas and Louisiana Inland | [2] 1,680 | 280 | | | | | 585 | |
| Rocky Mountain | 22,120 | 11,480 | | | 23,221 | 22,085 | 1,236 | 1,219 |
| Total United States | [2] 521,640 | 435,400 | [2] 297,288 | 278,060 | 96,915 | 90,251 | 48,077 | 39,089 |

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

*Average monthly refinery price of 122 to 124 white crude scale wax at Pennsylvania refineries, 1935–38, in cents per pound* [1]

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Average for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1935 | 3.08 | 2.83 | 2.28 | 2.13 | 2.13 | 2.13 | 2.13 | 2.00 | 2.07 | 2.13 | 2.88 | 2.33 | 2.29 |
| 1936 | 2.33 | 2.40 | 2.57 | 2.58 | 2.41 | 2.34 | 2.38 | 2.39 | 2.43 | 2.43 | 2.43 | 2.45 | 2.43 |
| 1937 | 2.53 | 2.65 | 2.68 | 2.69 | 2.73 | 2.88 | 2.95 | 2.96 | 2.95 | 2.98 | 2.98 | 2.91 | 2.82 |
| 1938 | 2.52 | 2.13 | 2.02 | 1.93 | 1.93 | 2.17 | 2.29 | 2.37 | 2.40 | 2.39 | 2.33 | 2.32 | 2.23 |

[1] National Petroleum News.

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*Comparative analyses of statistics for petroleum coke in the United States, 1937–38, by months and districts*

| | Production (thousands of short tons) | | Yield (percent) | | Domestic demands (thousands of short tons) | | Stocks (thousands of short tons) | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] |
| By months: | | | | | | | | |
| January | 102.2 | 126.2 | 0.5 | 0.6 | 104.1 | 107.0 | 384.1 | 389.5 |
| February | 91.6 | 122.0 | .5 | .7 | 88.7 | 83.2 | 379.7 | 418.8 |
| March | 107.2 | 114.0 | .6 | .6 | 80.2 | 61.6 | 403.3 | 468.5 |
| April | 101.8 | 127.0 | .5 | .7 | 79.9 | 62.6 | 411.7 | 522.3 |
| May | 109.6 | 137.8 | .5 | .7 | 104.8 | 84.4 | 339.2 | 561.6 |
| June | 99.6 | 137.0 | .5 | .7 | 74.7 | 114.7 | 390.5 | 574.3 |
| July | 109.6 | 137.6 | .5 | .7 | 96.5 | 89.0 | 380.1 | 609.8 |
| August | 113.0 | 148.4 | .5 | .7 | 95.1 | 94.5 | 375.5 | 650.6 |
| September | 113.4 | 110.8 | .5 | .6 | 117.2 | 127.3 | 360.4 | 622.6 |
| October | 127.0 | 146.8 | .6 | .7 | 141.2 | 88.3 | 329.2 | 653.8 |
| November | 111.2 | 152.8 | .6 | .8 | 69.4 | 104.0 | 366.2 | 678.4 |
| December | 120.4 | 141.8 | .6 | .7 | [2] 101.3 | 101.1 | 378.6 | 707.5 |
| Total United States | 1,306.6 | 1,602.2 | .6 | .7 | [2] 1,153.1 | 1,117.7 | 378.6 | 707.5 |
| By districts: | | | | | | | | |
| East Coast | 10.4 | 3.8 | [3] | [3] | | | 10.0 | 5.3 |
| Appalachian | 24.4 | 20.0 | .3 | .2 | | | 2.6 | 9.2 |
| Indiana, Illinois, Kentucky, etc. | 726.8 | 977.8 | 2.2 | 3.0 | | | 158.0 | 407.4 |
| Oklahoma, Kansas, and Missouri | 236.2 | 213.6 | 1.0 | 1.0 | | | 21.9 | 31.4 |
| Texas Inland | 106.2 | 101.4 | .7 | .7 | [4] | [4] | 64.6 | 93.2 |
| Texas Gulf Coast | 112.8 | 141.0 | .2 | .2 | | | 52.4 | 49.8 |
| Louisiana Gulf Coast | 16.6 | 60.6 | .2 | .6 | | | 8.6 | 30.4 |
| Arkansas and Louisiana Inland | 2.0 | 1.2 | [3] | [3] | | | .1 | ------- |
| Rocky Mountain | 70.8 | 65.8 | 1.5 | 1.3 | | | 56.7 | 62.4 |
| California | .4 | 17.0 | [3] | [3] | | | 3.7 | 18.4 |
| Total United States | 1,306.6 | 1,602.2 | .6 | .7 | [2] 1,153.1 | 1,117.7 | 378.6 | 707.5 |

[1] Subject to revision.
[2] Revised figures.
[3] Less than 0.1 percent.
[4] Figures not available.

## COKE

Although both domestic and export demand for coke receded in 1938, production increased from 1,306,600 short tons in 1937 to 1,602,200 in 1938 with a resultant increase in stocks of almost 100 percent—from 378,600 tons at the end of 1937 to 707,500 at the end of 1938. Domestic demand, which was 1,153,100 tons in 1937, dropped to 1,117,700 tons in 1938, and exports declined from 164,300 tons in 1937 to 155,600 in 1938.

## ASPHALT AND ROAD OIL

Asphalt statistics represent one of the few branches of the oil industry that improved in 1938 over 1937. Domestic demand increased from 3,977,400 short tons to 4,460,600 in 1938. Exports increased from 45,500 tons in 1937 to 50,200 in 1938, but imports at 33,200 tons were slightly lower than in 1937. The increase of 210,400 tons in production—from 4,182,000 in 1937 to 4,392,400 in 1938—was insufficient to meet the increased demand, resulting in reducing stocks from 566,100 tons at the end of 1937 to 480,900 at the end of 1938.

Domestic demand for road oil fell from 7,954,000 barrels in 1937 to 7,775,000 in 1938. Stocks increased from 667,000 barrels at the end

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of 1937 to 680,000 at the end of 1938, and production declined from 8,087,000 barrels in 1937 to 7,788,000 in 1938. Detailed statistics on asphalt and road oil appear in the chapter on Asphalt and Related Bitumens.

### STILL GAS

The production of still or refinery gas suffered the first significant set-back since separate statistics have been gathered for this product, the output in 1938 totaling 236,943 million cubic feet compared with 241,981 in 1937. At least part of this decline probably can be attributed to the conversion of the gas into gasoline by polymerization and it is reasonable to expect that the amount polymerized should increase in future.

Most of the still gas is employed for refinery fuel; it supplied 47 percent of the total B. t. u. used in refineries in 1937 compared with 34 percent in 1931. The proportion burned as refinery fuel declined from 98 percent in the first half of the decade to 93 percent in 1937, following the growth in sales to utility companies.

As the accompanying table shows, the Texas Gulf Coast district produced the greatest amount of any district, with Indiana-Illinois and East Coast, other districts important in cracking, following in order.

*Production of still gas in the United States, 1936–38, by districts*

| District | 1936 | | 1937 | | 1938 [1] | |
|---|---|---|---|---|---|---|
| | Millions of cubic feet | Equivalent in thousands of barrels | Millions of cubic feet | Equivalent in thousands of barrels | Millions of cubic feet | Equivalent in thousands of barrels |
| East Coast | 30,829 | 9,288 | 31,835 | 10,339 | 27,662 | 9,188 |
| Appalachian | 8,391 | 2,172 | 8,836 | 2,301 | 8,232 | 2,187 |
| Indiana, Illinois, Kentucky, etc. | 42,770 | 11,131 | 46,710 | 12,377 | 46,797 | 12,244 |
| Oklahoma, Kansas, Missouri | 24,297 | 6,212 | 26,721 | 6,968 | 21,935 | 5,775 |
| Texas Inland | 13,668 | 2,753 | 15,990 | 3,537 | 13,881 | 2,999 |
| Texas Gulf Coast | 65,092 | 14,902 | 70,240 | 17,893 | 76,150 | 19,039 |
| Louisiana Gulf Coast | 7,156 | 2,002 | 7,413 | 1,993 | 9,176 | 2,290 |
| Arkansas and Louisiana Inland | 4,200 | 951 | 3,894 | 899 | 2,505 | 552 |
| Rocky Mountain | 5,051 | 1,244 | 5,106 | 1,344 | 4,973 | 1,227 |
| California | 24,952 | 6,391 | 25,336 | 6,567 | 25,632 | 6,909 |
| Total United States | 226,466 | 57,046 | 241,981 | 64,218 | 236,943 | 62,410 |

[1] Subject to revision.

### MISCELLANEOUS PRODUCTS

Although the principal products of petroleum have been discussed on the foregoing pages many others are becoming increasingly more important. More than half of the production under this classification in 1937 was made up of liquefied petroleum gas (577,000 barrels), petrolatum (434,000 barrels), and absorption oil (201,000 barrels). Other products include alcohols, beautifiers, medicinal oils, lacquers, solvents, perfumes, glycerine, anaesthetics, plastics, and rubber.

The total demand for miscellaneous products declined from 2,249,000 barrels in 1937 to 1,776,000 in 1938, but exports increased from 101,000 to 112,000 barrels.

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*Production of miscellaneous oils, in the United States, 1936–37, by districts and classes* [1]

[Thousands of barrels]

| District | Petrolatum | Absorption oil | Medicinal oil | Specialties | Liquified petroleum gas | Other | Total |
|---|---|---|---|---|---|---|---|
| 1936 | | | | | | | |
| East Coast | 150 | 9 | 122 | 8 | 421 | 67 | 777 |
| Appalachian | 167 | 13 | | 11 | | 54 | 245 |
| Indiana, Illinois, Kentucky, etc. | 30 | | | 2 | 120 | 77 | 229 |
| Oklahoma, Kansas, and Missouri | 44 | 69 | | | | 42 | 155 |
| Texas Inland | | 65 | | | | | 65 |
| Texas Gulf Coast | 6 | | | 21 | 117 | 178 | 322 |
| Louisiana Gulf Coast | | 1 | | | | 25 | 26 |
| Arkansas and Louisiana Inland | | | | | | 23 | 23 |
| Rocky Mountain | 2 | | | | | 127 | 129 |
| California | | 42 | 34 | 6 | 46 | 49 | 177 |
| Total United States | 399 | 199 | 156 | 48 | 704 | 642 | 2,148 |
| 1937 | | | | | | | |
| East Coast | 147 | 18 | 130 | 12 | 388 | 73 | 768 |
| Appalachian | 200 | 9 | | | | 39 | 248 |
| Indiana, Illinois, Kentucky, etc. | 37 | | | 14 | 140 | 207 | 398 |
| Oklahoma, Kansas, and Missouri | 32 | 74 | | | | 46 | 152 |
| Texas Inland | | 59 | | | 5 | 104 | 168 |
| Texas Gulf Coast | 12 | 2 | | 25 | 37 | 220 | 296 |
| Louisiana Gulf Coast | | | | | 4 | 36 | 40 |
| Arkansas and Louisiana Inland | | 1 | | | | 9 | 10 |
| Rocky Mountain | 6 | 1 | | 6 | 3 | 101 | 117 |
| California | | 37 | 32 | 41 | | 75 | 185 |
| Total United States | 434 | 201 | 162 | 98 | 577 | 910 | 2,382 |

[1] Figures for 1938 not yet available.

## WORLD PRODUCTION [4]

The world production of crude petroleum was 3 percent less in 1938 than in 1937, the first decline since the depression of 1930–32. The general decrease was due primarily to a 5-percent curtailment in the production of the United States through proration, in response to a recession in domestic demand, despite new discoveries and increased export demand. Outside the United States the situation varied from country to country, but the total output of all foreign countries was virtually unchanged. North and South America continued to furnish more than three-fourths of the world total. In Venezuela, Colombia, and Trinidad production increased; but in Peru it declined. In Mexico the sharp drop in petroleum production was due to the dislocation of the export trade following expropriation of 17 foreign-owned oil companies on March 18, 1938. The decrease in the output of Rumania may be ascribed to the progressive decline of certain older fields and comparatively little prospecting, in spite of the discovery of new horizons in the Baicoi-Liliesti-Tzintea field. In the Near East a slight decrease in the output of Iran was counterbalanced

[4] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

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by small increases in the production of Iraq and Bahrein Island and new discoveries in Kuwait and Saudi Arabia. In the Far East, the production of Netherland India, of Sarawak and Brunei, and of Sakhalin increased. On the other hand, the production of British India and Burma declined from 1937 to 1938.

Determined efforts were made in countries of expanding domestic demand and insufficient domestic supply to expand their domestic production of crude petroleum. The U. S. S. R. increased its production of crude petroleum 4 percent from 1937 to 1938 but fell 13 percent below the quotas prescribed by the Five-Year Plan. Virtually all this output was consumed within the Soviet Union; less than 4 percent was exported during 1938. Germany increased its production more than one-fourth, not only by augmenting the output of the older fields but by discovering new fields and acquiring three new fields through the annexation of Austria. In Canada new discoveries in the Turner Valley field more than doubled the output of the Dominion in 1938 over 1937. In Argentina intensified drilling by the Government enterprise compensated for a decline in the output of private companies. Efforts to increase output in Poland and in Japan resulted only in unimportant increases.

*Crude petroleum produced in principal countries of the world, 1934–38, in thousands of barrels*

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|
| North America: | | | | | |
| Canada | 1,411 | 1,447 | 1,500 | 2,944 | 6,956 |
| Mexico | 38,172 | 40,241 | 41,028 | 46,907 | 34,794 |
| Trinidad | 10,894 | 11,671 | 13,237 | 15,503 | 17,736 |
| United States | 908,065 | 996,596 | 1,099,687 | 1,279,160 | 1,213,254 |
| Other North America | 28 | 47 | 62 | 33 | 32 |
| Total North America | 958,570 | 1,050,002 | 1,155,514 | 1,344,547 | 1,272,772 |
| South America: | | | | | |
| Argentina | 14,025 | 14,297 | 15,458 | 16,355 | 16,937 |
| Bolivia | 159 | 164 | 105 | 122 | 107 |
| Colombia | 17,341 | 17,598 | 18,756 | 20,298 | 22,450 |
| Ecuador | 1,637 | 1,732 | 1,951 | 2,161 | 2,246 |
| Peru | 16,314 | 17,067 | 17,593 | 17,457 | 15,839 |
| Venezuela | 136,103 | 148,254 | 154,794 | 186,775 | 187,369 |
| Total South America | 185,579 | 199,112 | 208,657 | 243,168 | 244,948 |
| Europe: | | | | | |
| Albania | 10 | 41 | 273 | 619 | 489 |
| Czechoslovakia | 178 | 133 | 127 | 122 | 132 |
| France | 557 | 541 | 503 | 502 | 516 |
| Germany | 2,187 | 2,996 | 3,115 | 3,176 | 4,074 |
| Austria | 28 | 44 | 50 | 221 | 366 |
| Hungary | | | | 16 | 318 |
| Italy | 150 | 119 | 123 | 110 | 101 |
| Poland | 3,913 | 3,812 | 3,788 | 3,716 | 3,763 |
| Rumania | 62,438 | 61,773 | 64,188 | 52,709 | 48,366 |
| U. S. S. R. [2] | 174,986 | 182,386 | 199,055 | 195,155 | 202,290 |
| Other Europe | 3 | 2 | 1 | 1 | 1 |
| Total Europe [2] | 244,450 | 251,847 | 271,223 | 256,347 | 260,416 |

[1] Subject to revision.
[2] Includes fields in Russian Asia other than Sakhalin.

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*Crude petroleum produced in principal countries of the world, 1934–38, in thousands of barrels*—Continued

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Asia: | | | | | |
| Bahrein Island | 285 | 1,265 | 4,645 | 7,762 | 8,298 |
| Burma | 7,279 | 7,181 | 7,588 | 7,848 | 7,572 |
| India, British | 1,922 | 2,038 | 1,978 | 2,162 | 1,420 |
| Iran (Persia) | 57,851 | 57,273 | 62,718 | 77,877 | 77,230 |
| Iraq | 7,689 | 27,408 | 30,406 | 31,836 | 32,643 |
| Japan (including Taiwan) | 1,821 | 2,249 | 2,440 | 2,488 | 2,557 |
| Netherland India | 46,529 | 47,171 | 50,025 | 56,724 | 57,481 |
| Sakhalin | 2,798 | 2,545 | 3,212 | 3,656 | [3] 3,900 |
| Sarawak and Brunei | 5,140 | 5,546 | 5,209 | 6,009 | 7,012 |
| Saudi Arabia | | | 20 | 65 | 495 |
| Total Asia [4] | 131,314 | 152,676 | 168,241 | 196,427 | 198,608 |
| Africa: | | | | | |
| Egypt | 1,546 | 1,301 | 1,278 | 1,196 | 1,561 |
| Other Africa | 6 | 4 | 3 | 22 | 27 |
| Total Africa | 1,552 | 1,305 | 1,281 | 1,218 | 1,588 |
| Australia and New Zealand | 5 | 5 | 5 | 4 | 4 |
| Undistributed | 4 | 4 | 4 | 4 | 4 |
| Grand total | 1,521,474 | 1,654,951 | 1,804,925 | 2,041,715 | 1,978,340 |

[3] Approximate production.
[4] Exclusive of U. S. S. R. fields in Asia, other than Sakhalin, which are included with U. S. S. R. in Europe.

## UNITED STATES TRADE [5]

*Imports.*—In keeping with the reduction in the domestic output of crude petroleum, total imports of mineral oils, crude and refined, into continental United States were 5 percent less in 1938 than in 1937. They constituted 4 percent of the total new supply of mineral oils both in 1937 and in 1938.

Receipts of foreign crude petroleum decreased 5 percent from 1937 to 1938. Venezuela was the principal source of these receipts, supplying 85 percent of the total imports in 1937 and 90 percent in 1938. Ninety-three percent of the total imports of crude were received at Atlantic coast ports in 1937 and 92 percent in 1938 and the remainder at Gulf coast ports.

Receipts of foreign refined and semirefined oils likewise declined. Imports of fuel oils into continental United States, chiefly in bond for supplies of vessels, were 5 percent less in 1938 than in 1937. Imports of unfinished oils for further refining, both dutiable and in bond, decreased 8 percent from 1937 to 1938. Of the total imports of 25,313,000 barrels of fuel oil and topped petroleum reported for 1938 by the Bureau of Foreign and Domestic Commerce, the Netherland West Indies furnished 24,919,000, Mexico 349,000, and Canada 45,000 barrels.

[5] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

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*Mineral oils, crude and refined, imported into continental United States, 1937–38, by months* [1]

[Thousands of barrels]

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total | For direct consumption | In bond |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | | | |
| Crude petroleum | 1,129 | 603 | 2,058 | 2,614 | 2,638 | 2,695 | 3,199 | 2,945 | 2,351 | 2,435 | 2,425 | 2,392 | 27,484 | 25,572 | 1,912 |
| Refined products: | | | | | | | | | | | | | | | |
| Gasoline, finished | | | | | | | | 1 | 58 | | 85 | | 144 | 2 | 142 |
| Gasoline, unfinished | | | | | | | | | 160 | 89 | 75 | 90 | 414 | | 414 |
| Gas oil and distillate fuel oils | | | | 1 | | | | | 15 | | 1 | | 17 | 16 | 1 |
| Residual fuel oil | 1,393 | 1,867 | 2,452 | 2,408 | 1,534 | 2,007 | 1,929 | 2,125 | 2,253 | 1,382 | 1,217 | 1,547 | 22,114 | 2,501 | 19,613 |
| Lubricating oil | | 1 | | 1 | 1 | | | 1 | 1 | | 1 | 1 | 7 | 3 | 4 |
| Paraffin wax | 7 | 8 | 5 | 5 | 14 | 10 | 21 | 13 | 13 | 10 | 6 | 20 | 132 | 130 | 2 |
| Asphalt | 2 | 27 | 28 | 7 | 54 | 16 | 13 | 4 | 1 | 17 | 17 | 2 | 188 | 188 | |
| Unfinished oils, other | 456 | 435 | 662 | 438 | 834 | 558 | 714 | 677 | 396 | 610 | 322 | 555 | 6,657 | 4,520 | 2,137 |
| | 2,987 | 2,941 | 5,205 | 5,474 | 5,075 | 5,286 | 5,876 | 5,766 | 5,248 | 4,543 | 4,149 | 4,607 | 57,157 | 32,932 | 24,225 |
| 1938 | | | | | | | | | | | | | | | |
| Crude petroleum | 2,095 | 1,883 | 2,569 | 1,827 | 2,081 | 2,192 | 2,565 | 1,714 | 1,574 | 2,693 | 2,359 | 2,860 | 26,412 | 22,761 | 3,651 |
| Refined products: | | | | | | | | | | | | | | | |
| Gasoline, finished | | | | | | | | | 79 | | | | 79 | | 79 |
| Gasoline, unfinished | 95 | | | | | | 54 | 100 | | | | | 249 | 100 | 149 |
| Residual fuel oil | 1,674 | 1,331 | 2,008 | 2,050 | 1,623 | 2,252 | 1,632 | 1,618 | 1,943 | 1,534 | 1,571 | 1,849 | 21,085 | 2,904 | 18,181 |
| Paraffin wax | 10 | 8 | 10 | 9 | 19 | 11 | 10 | 10 | 7 | 5 | 1 | 3 | 103 | 102 | 1 |
| Asphalt | 62 | 7 | 10 | 9 | 10 | 13 | 7 | 16 | 11 | 9 | 19 | 11 | 184 | 184 | |
| Unfinished oils, other | 281 | 426 | 297 | 293 | 288 | 283 | 497 | 1,211 | 636 | 600 | 673 | 646 | 6,131 | 4,100 | 2,031 |
| | 4,217 | 3,655 | 4,894 | 4,188 | 4,021 | 4,751 | 4,765 | 4,669 | 4,250 | 4,841 | 4,623 | 5,369 | 54,243 | 30,151 | 24,092 |

[1] Imports of crude as reported to the Bureau of Mines; imports of refined products compiled from data of the Bureau of Foreign and Domestic Commerce as of March 15, 1939; figures may differ slightly from those used throughout other sections of this report.

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*Crude petroleum imported into and exported from continental United States in 1938, by countries* [1]

[Thousands of barrels]

| | 1938 | | | | | | | | | | | | | 1937 (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total | |
| Imports: | | | | | | | | | | | | | | |
| For direct consumption: | | | | | | | | | | | | | | |
| Canada | | | | | | | | | | | 1 | | 1 | |
| Colombia | | | | | | | | | | | | | | 431 |
| Mexico | 304 | | 205 | | 121 | | 66 | 166 | 354 | 254 | 130 | | 1,600 | 3,512 |
| Trinidad and Tobago | | | | | | | | | | | | | | 180 |
| Venezuela | 1,511 | 1,914 | 1,904 | 1,603 | 1,523 | 1,860 | 2,230 | 1,361 | 1,079 | 1,836 | 1,716 | 2,213 | 20,850 | 21,272 |
| | 1,815 | 1,914 | 2,109 | 1,603 | 1,644 | 1,860 | 2,396 | 1,527 | 1,433 | 2,090 | 1,847 | 2,213 | 22,451 | 25,395 |
| Bonded for manufacture and export: | | | | | | | | | | | | | | |
| Mexico | | | | | | | | | | 258 | 304 | 320 | 882 | |
| Venezuela | 109 | 131 | 296 | 414 | 278 | 270 | 273 | 193 | 151 | 300 | 157 | 145 | 2,717 | 1,915 |
| Total imports | 1,924 | 2,045 | 2,405 | 2,017 | 1,922 | 2,130 | 2,669 | 1,720 | 1,584 | 2,648 | 2,308 | 2,678 | 26,050 | 27,310 |
| Exports: | | | | | | | | | | | | | | |
| North America: | | | | | | | | | | | | | | |
| Canada | 954 | 995 | 1,327 | 1,676 | 2,821 | 3,122 | 2,780 | 2,827 | 2,374 | 3,103 | 1,523 | 1,343 | 24,845 | 28,080 |
| Cuba | 79 | 80 | 81 | 131 | 80 | 81 | 152 | | | 80 | 63 | 78 | 905 | 905 |
| Mexico | 11 | 9 | 10 | 2 | 5 | 5 | 86 | 2 | 3 | 3 | 3 | 4 | 143 | 142 |
| Netherland West Indies | | | | | | | | | | | | | | 842 |
| South America: | | | | | | | | | | | | | | |
| Argentina | | 93 | 101 | 292 | 97 | 208 | 100 | 101 | 99 | 109 | 97 | 207 | 1,504 | 1,420 |
| Brazil | | | | | | | | | | | 1 | | 1 | 118 |
| Europe: | | | | | | | | | | | | | | |
| Belgium | | | 64 | | | 164 | | 49 | | 72 | | | 349 | 447 |
| Czechoslovakia | | | | | 71 | | | | | | | | 71 | 300 |
| France | 1,018 | 1,694 | 1,191 | 1,574 | 1,619 | 987 | 1,915 | 1,110 | 1,371 | 1,420 | 1,452 | 1,392 | 16,743 | 10,066 |
| Germany | 193 | 396 | | 70 | | 70 | | 69 | 99 | 70 | 242 | 78 | 1,287 | 1,430 |
| Italy | 651 | 344 | 674 | 712 | 420 | 523 | 631 | 577 | 579 | 482 | 782 | 376 | 6,751 | 4,544 |
| Malta, Gozo, and Cyprus | | | | | | | | | | | | | | 120 |
| Netherlands | 108 | | 40 | | 21 | 21 | | | 19 | 53 | | 64 | 326 | 309 |
| Sweden | 92 | 155 | 109 | 101 | 158 | | 108 | 44 | 30 | | 101 | 32 | 930 | 363 |
| Switzerland | | | | | | 280 | | | | | | | 280 | |
| United Kingdom | | | 56 | | | | 33 | | | | | | 89 | 753 |
| Asia: | | | | | | | | | | | | | | |
| China | | | 166 | | | | | | | | | | 166 | |
| Japan | 2,683 | 1,459 | 2,298 | 2,949 | 2,340 | 1,963 | 1,353 | 1,965 | 826 | 1,164 | 1,154 | 1,136 | 21,290 | 15,995 |
| Kwantung | 164 | | | | 92 | | 92 | 99 | 91 | 190 | 99 | 90 | 917 | 673 |
| Africa: Union of South Africa | | | | 45 | | | | 100 | | | | 72 | 217 | 203 |
| Other countries | | 103 | 4 | 1 | 74 | | | 60 | 86 | 34 | 85 | 11 | 458 | 418 |
| Noncontiguous Territories | | | | | | | | | | | | | | 103 |
| Total exports | 5,953 | 5,328 | 6,121 | 7,553 | 7,798 | 7,424 | 7,250 | 7,003 | 5,577 | 6,780 | 5,602 | 4,883 | 77,272 | 67,231 |
| Net exports | 4,029 | 3,283 | 3,716 | 5,536 | 5,876 | 5,294 | 4,581 | 5,283 | 3,993 | 4,132 | 3,294 | 2,205 | 51,222 | 39,921 |

[1] Bureau of Foreign and Domestic Commerce.

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*Exports.*—In spite of these imports the United States continued to be a petroleum-exporting country. Net exports of crude petroleum increased 28 percent—from 39,921,000 barrels in 1937 to 51,222,000 in 1938. Net outward shipments of refined products from continental United States increased 17 percent—from 75,927,000 barrels in 1937 to 88,619,000 in 1938. Exports and Territorial shipments constituted 13 percent of the total demand in 1937 and 15 percent in 1938. Although imports consisted almost entirely of crude petroleum, bunker oil, and semirefined oils for further processing, obtained from neighboring countries of North and South America, exports and Territorial shipments included not only crude petroleum but a wide variety of finished products shipped to all parts of the earth.

Exports of crude petroleum were 15 percent greater in 1938 than in 1937. More United States crude was purchased by France, Japan, Italy, and Sweden, countries in which the domestic refining of crude petroleum is encouraged by Government policy. On the other hand, Canada, the principal foreign purchaser of United States crude, took 12 percent less crude from the United States in 1938 than in 1937. Increased production of high-grade petroleum in Alberta and larger imports from Colombia were responsible for this decline. The United Kingdom likewise decreased its purchases of crude from the United States, as well as from Peru and Mexico, but took more from the Netherland West Indies, Venezuela, and Iraq. Sales of crude petroleum to Czechoslovakia, Germany, and Brazil were also less in 1938 than in 1937. Virtually no crude petroleum was shipped to the noncontiguous Territories in 1938, although 103,000 barrels were shipped to Hawaii in 1937.

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*Mineral oils, crude and refined, shipped from continental United States and including shipments to noncontiguous Territories, 1937–38, by months* [1]

[Thousands of barrels]

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| Crude petroleum | 3,596 | 3,776 | 3,196 | 4,899 | 6,795 | 6,180 | 6,363 | 7,423 | 6,602 | 6,640 | 6,645 | 5,116 | 67,231 |
| Refined products: | | | | | | | | | | | | | |
| Motor fuel [2] | 3,103 | 2,653 | 2,517 | 2,787 | 3,333 | 3,086 | 2,961 | 3,824 | 4,455 | 3,826 | 3,307 | 2,441 | 38,293 |
| Kerosene | 648 | 819 | 414 | 791 | 665 | 623 | 1,116 | 975 | 772 | 708 | 691 | 663 | 8,885 |
| Gas oil and distillate fuel oils | 2,197 | 1,533 | 1,960 | 2,511 | 2,790 | 2,633 | 3,090 | 3,046 | 2,956 | 2,565 | 2,826 | 2,021 | 30,128 |
| Residual fuel oil | 1,401 | 715 | 1,359 | 1,450 | 1,254 | 1,183 | 1,258 | 1,256 | 1,197 | 1,187 | 2,073 | 971 | 15,304 |
| Lubricating oils | 718 | 973 | 717 | 1,040 | 1,141 | 981 | 876 | 1,116 | 837 | 940 | 799 | 837 | 10,975 |
| Paraffin wax | 64 | 83 | 82 | 69 | 92 | 68 | 58 | 53 | 53 | 63 | 64 | 79 | 828 |
| Coke | 17 | 37 | 17 | 68 | 86 | 168 | 117 | 112 | 57 | 85 | 24 | 34 | 822 |
| Asphalt | 4 | 10 | 34 | 36 | 32 | 26 | 12 | 17 | 13 | 25 | 21 | 20 | 250 |
| Miscellaneous oils | 5 | 5 | 8 | 11 | 13 | 6 | 12 | 6 | 8 | 16 | 7 | 4 | 101 |
| Total refined | 8,157 | 6,828 | 7,108 | 8,763 | 9,406 | 8,774 | 9,500 | 10,405 | 10,348 | 9,415 | 9,812 | 7,070 | 105,586 |
| Total crude and refined | 11,753 | 10,604 | 10,304 | 13,662 | 16,201 | 14,954 | 15,863 | 17,828 | 16,950 | 16,055 | 16,457 | 12,186 | 172,817 |
| 1938 | | | | | | | | | | | | | |
| Crude petroleum | 5,953 | 5,328 | 6,121 | 7,553 | 7,798 | 7,424 | 7,250 | 7,003 | 5,577 | 6,780 | 5,602 | 4,884 | 77,273 |
| Refined products: | | | | | | | | | | | | | |
| Motor fuel [2] | 3,087 | 3,930 | 3,562 | 4,473 | 4,577 | 4,283 | 4,189 | 4,829 | 3,527 | 4,525 | 3,697 | 5,420 | 50,099 |
| Kerosene | 837 | 687 | 541 | 812 | 779 | 403 | 219 | 603 | 813 | 683 | 324 | 803 | 7,504 |
| Gas oil and distillate fuel oils | 2,256 | 2,151 | 2,810 | 2,687 | 2,561 | 2,980 | 2,897 | 2,614 | 2,427 | 1,574 | 2,269 | 2,412 | 29,638 |
| Residual fuel oil | 869 | 911 | 1,521 | 1,473 | 1,690 | 1,613 | 1,790 | 1,723 | 1,680 | 1,644 | 1,270 | 1,737 | 17,921 |
| Lubricating oils | 819 | 800 | 655 | 860 | 901 | 913 | 708 | 800 | 852 | 715 | 702 | 676 | 9,401 |
| Paraffin wax | 42 | 38 | 55 | 41 | 68 | 70 | 52 | 49 | 86 | 84 | 54 | 80 | 719 |
| Coke | 41 | 48 | 14 | 53 | 70 | 48 | 66 | 65 | 58 | 136 | 121 | 58 | 778 |
| Asphalt | 18 | 34 | 30 | 24 | 22 | 16 | 23 | 11 | 27 | 24 | 19 | 30 | 278 |
| Miscellaneous oils | 13 | 5 | 15 | 4 | 14 | 10 | 7 | 5 | 15 | 3 | 4 | 17 | 112 |
| Total refined | 7,982 | 8,604 | 9,203 | 10,427 | 10,682 | 10,336 | 9,951 | 10,699 | 9,485 | 9,388 | 8,460 | 11,233 | 116,450 |
| Total crude and refined | 13,935 | 13,932 | 15,324 | 17,980 | 18,480 | 17,760 | 17,201 | 17,702 | 15,062 | 16,168 | 14,062 | 16,117 | 193,723 |

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce as of March 15, 1939, figures may differ slightly from those used throughout other sections of this report.
[2] Includes benzol and natural gasoline.

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Europe was still the principal external market for American refined oils, taking 40 percent of the motor fuel, kerosene, gas oil and fuel oil, and lubricating oils shipped from continental United States in 1937 and 47 percent in 1938. In spite of increased production of crude petroleum, of the intensive cultivation of substitute motor fuels, and of determined efforts to stimulate the refining of petroleum, Europe remains the major importing area for refined oils in international trade. Although the Netherland West Indies, Rumania, Iran, and Netherland India are rival sources of supply, the United States continued to supply in 1938 about one-sixth of the growing European requirements for refined mineral oils and about one-fourth of the European requirements if the exports of crude petroleum to be processed in European refineries are included.

Exports and Territorial shipments of motor fuel (including refinery gasoline, natural gasoline, naphthas and solvents, and benzol) showed the largest proportional increase of all forms of petroleum shipped from continental United States—a 31 percent advance in 1938 from 1937. The principal increases were in exports to northern and western Europe and to the Netherland West Indies, presumably for reshipment to Europe. Exports to Canada likewise increased considerably. The only noteworthy decrease was in exports to Africa. As in 1937, Soviet Asia found it more convenient to purchase gasoline from the Pacific coast of the United States than to receive shipments from Batum.

As in 1937, refineries of the Texas and Louisiana Gulf coast and of California furnished nearly seven-eighths of the exports and Territorial shipments of motor fuel.

*Major petroleum products shipped from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1937–38* [1]

[Thousands of barrels, except wax, which is in thousands of pounds]

| | Motor fuel [2] | | Kerosene | | Gas oil and fuel oil | | Lubricating oil | | Wax | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 [3] | 1937 | 1938 [3] | 1937 | 1938 [3] | 1937 | 1938 [3] | 1937 | 1938 [3] |
| Exports to foreign countries: | | | | | | | | | | |
| North America: | | | | | | | | | | |
| Canada | 1,740 | 3,276 | 84 | 229 | 1,322 | 1,528 | 440 | 486 | 2,247 | 11,016 |
| Cuba | 739 | 778 | (4) | ------ | 423 | 1,473 | 112 | 37 | 2,501 | 2,414 |
| Mexico | 247 | 238 | 25 | 22 | 1,466 | 1,268 | 99 | 87 | 13,269 | 16,831 |
| Netherland West Indies | 3,629 | 4,852 | 1,294 | 1,209 | 5,279 | 5,111 | 7 | 12 | 1 | ------ |
| Panama (including Canal Zone) | 173 | 235 | 37 | 48 | 1,672 | 1,798 | 10 | 9 | 391 | 135 |
| Other North America | 278 | 284 | 136 | 128 | 734 | 446 | 50 | 65 | 6,255 | 6,312 |
| | 6,806 | 9,663 | 1,576 | 1,636 | 10,896 | 11,624 | 718 | 696 | 24,664 | 36,708 |
| South America: | | | | | | | | | | |
| Argentina | 5 | 26 | 1 | ------ | ------ | ------ | 37 | 29 | 4,355 | 4,013 |
| Brazil | 1,413 | 1,460 | 523 | 401 | 69 | 482 | 277 | 243 | 2,331 | 1,860 |
| Chile | 174 | 216 | 23 | 28 | 2,878 | 2,546 | 58 | 59 | 2,579 | 3,770 |
| Colombia | 12 | 16 | (4) | ------ | (4) | 2 | 17 | 17 | 5,625 | 6,540 |
| Other South America | 130 | 172 | 69 | 29 | 321 | 195 | 97 | 112 | 12,892 | 9,805 |
| | 1,734 | 1,890 | 616 | 458 | 3,268 | 3,225 | 486 | 460 | 27,782 | 25,988 |

See footnotes at end of table.

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*Major petroleum products shipped from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1937–38*—Continued

[Thousands of barrels, except wax, which is in thousands of pounds]

| | Motor fuel[2] | | Kerosene | | Gas oil and fuel oil | | Lubricating oil | | Wax | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938[3] | 1937 | 1938[3] | 1937 | 1938[3] | 1937 | 1938[3] | 1937 | 1938[3] |
| Exports to foreign countries—Con. | | | | | | | | | | |
| Europe: | | | | | | | | | | |
| Belgium | 2,188 | 1,383 | 28 | 51 | 1,579 | 1,151 | 978 | 799 | 12,174 | 15,271 |
| Denmark | 398 | 660 | 56 | 496 | 280 | 715 | 204 | 205 | 2,348 | 2,243 |
| Finland | 129 | 267 | 20 | 67 | ------ | 37 | 16 | 21 | 1,296 | 1,236 |
| France | 2,587 | 3,825 | 1 | 9 | 978 | 240 | 441 | 529 | 576 | 1,101 |
| Germany | 1,179 | 2,313 | 104 | 1 | 2,690 | 4,026 | 1,232 | 1,235 | 29,905 | 4,219 |
| Ireland | 207 | 177 | 55 | 20 | 15 | 16 | 5 | 6 | 2,627 | 2,441 |
| Italy | 595 | 432 | 94 | ------ | 721 | 1,201 | 373 | 306 | 21,058 | 22,104 |
| Netherlands | 2,279 | 2,417 | 1,094 | 696 | 2,721 | 3,065 | 482 | 192 | 7,078 | 5,897 |
| Norway | 206 | 263 | 161 | 104 | 398 | 414 | 36 | 33 | 1,268 | 1,052 |
| Portugal | 163 | 293 | 93 | 115 | 42 | 98 | 94 | 38 | 1,760 | 1,761 |
| Spain | 828 | 2,095 | ------ | 12 | 301 | 731 | 37 | 106 | 1,655 | 2,018 |
| Sweden | 826 | 2,390 | 269 | 421 | 1,179 | 908 | 157 | 159 | 8,412 | 7,403 |
| United Kingdom | 5,655 | 10,031 | 1,294 | 1,555 | 2,447 | 4,044 | 2,519 | 2,459 | 58,440 | 45,232 |
| Other Europe | 181 | 205 | 62 | 90 | 593 | 334 | 131 | 114 | 2,951 | 2,632 |
| | 17,412 | 26,751 | 3,331 | 3,637 | 13,944 | 16,980 | 6,705 | 6,202 | 151,548 | 114,610 |
| Asia: | | | | | | | | | | |
| India, British (including Burma) | 2 | 87 | 3 | 12 | 30 | 51 | 570 | 323 | 1,423 | 1,029 |
| China, Hong Kong, and Kwantung | 1,213 | 740 | 1,432 | 337 | 1,036 | 619 | 434 | 163 | 6,706 | 6,558 |
| Japan | 1,434 | 1,479 | 181 | 1 | 10,353 | 8,327 | 444 | 289 | 143 | 46 |
| Philippine Islands | 770 | 952 | 412 | 509 | 734 | 1,209 | 111 | 79 | 860 | 528 |
| U. S. S. R. | 1,544 | 1,547 | ------ | ------ | 3 | ------ | (4) | ------ | ------ | ------ |
| Other Asia | 284 | 742 | 312 | 259 | 202 | 278 | 215 | 174 | 964 | 654 |
| | 5,247 | 5,547 | 2,340 | 1,118 | 12,358 | 10,484 | 1,774 | 1,028 | 10,096 | 8,815 |
| Africa: | | | | | | | | | | |
| Union of South Africa | 1,149 | 619 | 198 | 20 | 40 | 78 | 159 | 117 | 3,890 | 3,401 |
| Other Africa | 1,320 | 556 | 269 | 150 | 960 | 1,169 | 397 | 323 | 12,747 | 11,175 |
| | 2,469 | 1,175 | 467 | 170 | 1,000 | 1,247 | 556 | 440 | 16,637 | 14,576 |
| Oceania: | | | | | | | | | | |
| Australia | 1,884 | 1,994 | 281 | 169 | 20 | 22 | 487 | 415 | 882 | 556 |
| New Zealand | 631 | 873 | 55 | 62 | 276 | 196 | 110 | 69 | 52 | 149 |
| Other Oceania | 87 | 65 | 18 | 12 | 59 | 54 | 3 | 2 | (4) | ------ |
| | 2,602 | 2,932 | 334 | 243 | 355 | 272 | 600 | 486 | 934 | 705 |
| | 36,270 | 47,958 | 8,664 | 7,262 | 41,821 | 43,832 | 10,839 | 9,312 | 231,661 | 201,402 |
| Shipments to noncontiguous Territories: | | | | | | | | | | |
| Alaska | 218 | 225 | 9 | 8 | 1,039 | 1,090 | 16 | 17 | 9 | b |
| Hawaii | 1,173 | 1,264 | 123 | 147 | 2,491 | 2,401 | 97 | 49 | 27 | 9 |
| Puerto Rico | 677 | 696 | 109 | 108 | 104 | 261 | 26 | 25 | 22 | 28 |
| Virgin Islands | 18 | 21 | 4 | 4 | 5 | 4 | 1 | 1 | 2 | 3 |
| | 2,086 | 2,206 | 245 | 267 | 3,639 | 3,756 | 140 | 92 | 60 | 45 |
| Exports from noncontiguous Territories: | | | | | | | | | | |
| Alaska | 13 | 12 | ------ | ------ | 16 | 16 | 1 | 1 | ------ | ------ |
| Puerto Rico | 50 | 53 | 24 | 25 | 12 | 13 | 3 | 2 | ------ | ------ |
| Virgin Islands | ------ | ------ | ------ | 1 | ------ | ------ | ------ | ------ | ------ | ------ |
| | 63 | 65 | 24 | 26 | 28 | 29 | 4 | 3 | ------ | ------ |
| Total shipments from United States | 38,293 | 50,099 | 8,885 | 7,503 | 45,432 | 47,559 | 10,975 | 9,401 | 231,721 | 201,447 |

[1] Bureau of Foreign and Domestic Commerce as of Mar. 15, 1939; figures may differ slightly from those used throughout other sections of this report.
[2] Includes natural gasoline, naphtha, and benzol
[3] Subject to revision.
[4] Less than 1,000 barrels.

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Although the United Kingdom, Sweden, Denmark, and Canada increased their purchases of American kerosene in 1938, the failure of China, Hong Kong, Kwantung, Japan, and the Netherlands to take their customary quantities of lamp oil from the United States led to a decline of 16 percent in shipments of kerosene from continental United States from 1937 to 1938. Kerosene sales to South America, to Africa, and to Australia were also appreciably less in 1938 than in 1937.

A decrease of 2.5 percent in exports of gas oil and distillate fuel oils (from 29,011,000 barrels in 1937 to 28,296,000 in 1938) was more than counterbalanced by an increase of 21 percent in exports of residual fuel oils (from 12,810,000 barrels in 1937 to 15,546,000 in 1938). However, gas oil and distillate fuel oils made up 69 percent of the exports of this group in 1937 and 65 percent in 1938. Large increases in exports of gas oil and distillate fuel oils to the United Kingdom and to Germany did not fully suffice to offset the general decline in similar exports to Europe, the Far East (except for the Philippine Islands), and Latin America (except Mexico). Increased exports of residual fuel oils to Cuba, to Italy, to the Netherlands, to Spain, and to the United Kingdom, as well as to the Philippine Islands, Panama, and Canada, were more than enough to offset declines in exports to Japan, the Canary Islands, Belgium, Mexico, and Greece.

The decline in exports of lubricating oils was general but was greatest in shipments to Europe and to Asia, the two major foreign markets. Decreased sales to the United Kingdom and to the Far East outweighed increased sales to Canada, France, Spain, and smaller foreign consumers.

Shipments of wax from continental United States were 13 percent less in 1938 than in 1937. The largest losses were in sales to Germany, the United Kingdom, Scandinavia, China, and the Union of South Africa. Nevertheless, more wax was sold to Canada, Mexico, Chile, Colombia, Belgium, and Spain in 1938 than in 1937.

*Motor fuel exported and shipped to noncontiguous Territories from continental United States in 1938, by refinery districts and months* [1]

[Thousands of barrels]

| Refinery district | January | February | March | April | May | June |
|---|---|---|---|---|---|---|
| East Coast | 71 | 70 | 233 | 228 | 128 | 114 |
| Appalachian | 12 | 12 | 15 | 20 | 22 | 10 |
| Indiana, Illinois, Kentucky, etc | 11 | 12 | 13 | 9 | 10 | 9 |
| Texas Inland | 20 | 304 | 99 | 246 | 326 | 155 |
| Texas Gulf Coast | 1,820 | 2,296 | 2,042 | 2,326 | 2,342 | 2,600 |
| Louisiana Gulf Coast | 216 | 161 | 27 | 292 | 131 | 133 |
| Rocky Mountain | 15 | 13 | 21 | 33 | 42 | 40 |
| California | 922 | 1,062 | 1,112 | 1,319 | 1,576 | 1,222 |
| Total United States | 3,087 | 3,930 | 3,562 | 4,473 | 4,577 | 4,283 |

| Refinery district | July | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|---|
| East Coast | 94 | 38 | 230 | 129 | 47 | 132 | 1,514 |
| Appalachian | 15 | 14 | 31 | 35 | 45 | 55 | 286 |
| Indiana, Illinois, Kentucky, etc | 15 | 15 | 19 | 22 | 20 | 13 | 168 |
| Texas Inland | 191 | 431 | 248 | 299 | 284 | •410 | 3,013 |
| Texas Gulf Coast | 2,218 | 2,464 | 1,784 | 2,442 | 2,145 | 2,829 | 27,308 |
| Louisiana Gulf Coast | 248 | 242 | 209 | 292 | 344 | 166 | 2,461 |
| Rocky Mountain | 39 | 50 | 50 | 37 | 28 | 21 | 389 |
| California | 1,369 | 1,575 | 956 | 1,269 | 784 | 1,794 | 14,960 |
| Total United States | 4,189 | 4,829 | 3,527 | 4,525 | 3,697 | 5,420 | 50,099 |

[1] Compiled from data of Bureau of Foreign and Domestic Commerce as of March 15, 1939; figures may differ slightly from those used throughout other sections of this report.

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*Intercoastal shipments.*—The 9-percent reduction in runs to stills in East Coast refineries was complemented by a 12-percent decrease in their receipts of crude petroleum by tanker from Gulf coast ports from 1937 to 1938. These receipts were equivalent to 86 percent of the total crude petroleum run to stills in East Coast refineries in 1937 and 83 percent in 1938. Receipts of all types of refined products on the East coast from Gulf coast ports increased 3 percent from 1937 to 1938.

Shipments of mineral oils from California to Atlantic ports of the United States by way of the Panama Canal decreased 9 percent from 1937 to 1938. The only increases in these shipments were in crude petroleum and in residual fuel oils. Nevertheless shipments from California made only an insignificant contribution to the mineral oils, crude and refined, available for consumption in the East Coast area.

*Mineral oils, crude and refined, shipped from Gulf coast to East coast ports of the United States, 1937–38* [1]

[Thousands of barrels]

| | 1938 | | | | | | |
|---|---|---|---|---|---|---|---|
| | January | February | March | April | May | June | July |
| Crude petroleum | 13,985 | 12,761 | 13,054 | 12,053 | 11,893 | 11,430 | 12,345 |
| Gasoline | 8,119 | 6,100 | 8,689 | 8,681 | 9,734 | 8,997 | 9,188 |
| Kerosene | 2,112 | 1,935 | 1,835 | 1,225 | 1,031 | 759 | 1,281 |
| Gas oil and distillate fuel oils | 3,185 | 3,761 | 2,667 | 1,864 | 1,647 | 1,510 | 1,651 |
| Residual fuel oils | 5,793 | 5,016 | 6,315 | 4,297 | 3,627 | 3,390 | 4,217 |
| Lubricating oils | 206 | 265 | 198 | 240 | 284 | 250 | 439 |
| Miscellaneous oils | 3 | 19 | 24 | 138 | 58 | 70 | 67 |
| | 33,403 | 29,857 | 32,782 | 28,498 | 28,274 | 26,406 | 29,188 |

| | 1938—Continued | | | | | | 1937 (total) |
|---|---|---|---|---|---|---|---|
| | August | September | October | November | December | Total | |
| Crude petroleum | 12,153 | 12,775 | 11,891 | 12,916 | 13,460 | 150,716 | 170,776 |
| Gasoline | 9,217 | 8,964 | 9,372 | 9,371 | 8,604 | 105,036 | 104,127 |
| Kerosene | 1,609 | 1,530 | 2,029 | 1,753 | 2,816 | 19,915 | 18,330 |
| Gas oil and distillate fuel oils | 2,089 | 2,063 | 2,447 | 2,503 | 3,800 | 29,187 | 27,452 |
| Residual fuel oils | 4,452 | 3,595 | 4,675 | 4,527 | 7,083 | 56,987 | 56,891 |
| Lubricating oils | 489 | 661 | 313 | 471 | 635 | 4,451 | 3,186 |
| Miscellaneous oils | 5 | 8 | 16 | 15 | 71 | 494 | 263 |
| | 30,014 | 29,596 | 30,743 | 31,556 | 36,469 | 366,786 | 381,025 |

[1] Petroleum Conservation Division, U. S. Department of the Interior.

*Mineral oils, crude and refined, shipped from California to East coast ports of the United States, 1937–38*

[Thousands of barrels]

| | 1938 | | | | | | | | | | | | | 1937 (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total | |
| Crude petroleum | ---- | ---- | 70 | 70 | 62 | 143 | 149 | 209 | 74 | 75 | 71 | ----- | 923 | 121 |
| Gasoline | 266 | 81 | 204 | 390 | 430 | 361 | 330 | 240 | 202 | 160 | 246 | 55 | 2,965 | 4,144 |
| Kerosene | 61 | ---- | 72 | 67 | ----- | ----- | ----- | 73 | ----- | 77 | ----- | ----- | 350 | 476 |
| Gas oil and distillate fuel oils | 179 | ---- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 73 | 69 | 321 | 726 |
| Residual fuel oils | ---- | ---- | ---- | ---- | ----- | ----- | ----- | ----- | ----- | 59 | 71 | 208 | 338 | ----- |
| Asphalt and road oils | 73 | ---- | 73 | 63 | 138 | ----- | 72 | ----- | 71 | ----- | 1 | ----- | 491 | 415 |
| Miscellaneous oils | 1 | 1 | 4 | 3 | 9 | 1 | 4 | ----- | 2 | 5 | 2 | 1 | 33 | 49 |
| | 580 | 82 | 423 | 593 | 639 | 505 | 555 | 522 | 349 | 376 | 464 | 333 | 5,421 | [1] 5,931 |

[1] Revised figures; miscellaneous oils in July revised to 79 (Minerals Yearbook, 1938, p. 905).

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# NATURAL GAS [1]

By F. S. Lott and G. R. Hopkins [2]

## SUMMARY OUTLINE


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The natural-gas industry experienced a moderate shrinkage in demand in 1938 after 4 years of rapid recovery from the depression low of 1933. Total marketed production had increased 55 percent, from 1,555,000,000,000 cubic feet in 1933 to 2,408,000,000,000 in 1937. However, because of generally adverse business conditions in 1938, marketed production is estimated to have declined to 2,263,000,000,000 cubic feet, or 6 percent below 1937.

Capital expenditures in the production and transportation branches of the industry were much lower than in 1937, as existing facilities were generally adequate for the requirements of current markets. Since the period, 1928–32, when many long-distance gas lines were constructed, managements have emphasized expanding the volume to utilize excess capacity and improving load factors, but at profitable rates. There appear to have been two restraining influences in the last 2 or 3 years upon the extension of pipe lines to new markets. One is the activity in many localities of groups sponsoring competing fuels. The other is the stagnation of capital markets for durable goods, which has almost eliminated public financing as a means of raising money for new gas enterprises.

Estimated consumption of natural gas in the United States was 2,261,285,000,000 cubic feet in 1938, a decrease of 6 percent from the 1937 total of 2,403,041,000,000 cubic feet. The average value at points of consumption is estimated to have increased in 1938 to about 22.1 cents per thousand cubic feet from 22.0 cents in 1937, owing to gains in domestic and commercial values that more than balanced a decline in the average value of gas used for all industrial purposes. In recent years domestic and commercial demand has grown more in States where average sales values exceed the national average than it has in States with below-average rates. This trend is due to the development of important new markets remote from major gas-producing areas and has caused the average value of gas used by these groups of

[1] Data for 1938 are prelimary; detailed statistics with final revisions will be released later.
[2] Tables compiled by H. Backus, Petroleum Economics Division, Bureau of Mines.



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consumers to be sustained in spite of generally declining rates in nearly all consuming areas. The total value at points of consumption of natural gas used in the United States dropped 5 percent in 1938 to about $500,000,000 from $527,529,000 in 1937.

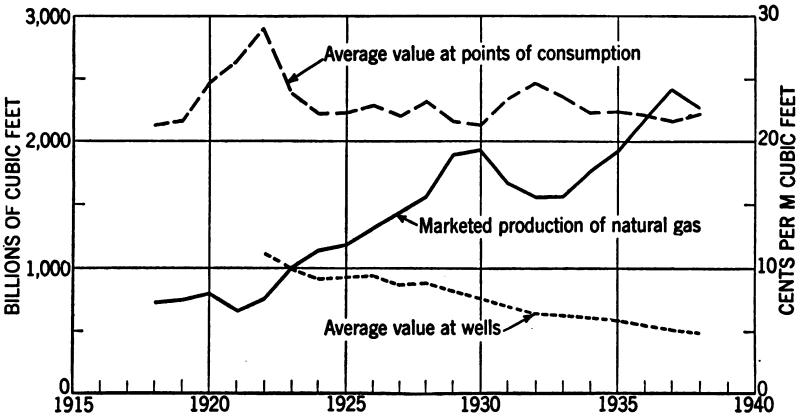


FIGURE 1.—Production and value of natural gas, 1918-38.

As shown in figure 1, the average value of natural gas at the wells is estimated to have decreased from 5.1 cents per thousand cubic feet in 1937 to 4.9 cents in 1938 and the total value from $123,457,000 to about $111,000,000, or 10 percent.

*Summary of statistics for natural gas in the United States, 1933–38*

| | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 [1] |
|---|---|---|---|---|---|---|
| Marketed production: | | | | | | |
| California.....millions of cubic feet | 259,799 | 268,122 | 284,109 | 320,406 | 329,769 | 315,000 |
| Louisiana.....do | 197,826 | 225,713 | 249,450 | 290,151 | 315,301 | 280,000 |
| Oklahoma.....do | 245,759 | 254,457 | 274,313 | 280,481 | 296,260 | 260,000 |
| Texas.....do | 475,691 | 602,976 | 642,366 | 734,561 | 854,561 | 845,000 |
| West Virginia.....do | 100,653 | 109,161 | 115,772 | 138,076 | 149,084 | 132,000 |
| Other States.....do | 275,746 | 310,292 | 350,585 | 404,127 | 462,645 | 431,000 |
| Total production.....do | 1,555,474 | 1,770,721 | 1,916,595 | 2,167,802 | 2,407,620 | 2,263,000 |
| Exports: | | | | | | |
| To Canada.....do | 69 | 73 | 73 | 84 | 78 | 90 |
| To Mexico.....do | 2,089 | 5,728 | 6,727 | 7,352 | 4,790 | 2,000 |
| Imports from Canada.....do | 83 | 68 | 106 | 152 | 289 | 375 |
| Consumption: | | | | | | |
| Domestic.....do | 283,197 | 288,236 | 313,498 | 343,346 | 371,844 | 362,000 |
| Commercial.....do | 85,577 | 91,261 | 100,187 | 111,623 | 117,390 | 114,000 |
| Industrial: | | | | | | |
| Field.....do | 491,159 | 554,542 | 580,414 | 618,468 | 651,320 | 620,000 |
| Carbon-black plants.....do | 190,081 | 229,933 | 241,589 | 283,421 | 341,085 | 325,000 |
| Petroleum refineries.....do | 66,333 | 79,965 | 80,175 | 93,183 | 113,005 | 122,000 |
| Electric public-utility power plants [2] millions of cubic feet | 102,601 | 127,896 | 125,239 | 156,080 | 170,567 | 170,688 |
| Portland-cement plants [3].....do | 22,001 | 27,331 | 26,752 | 36,923 | 40,450 | 37,336 |
| Other industrial.....do | 312,450 | 365,824 | 442,047 | 517,474 | 597,380 | 510,261 |
| Total consumption.....do | 1,553,399 | 1,764,988 | 1,909,901 | 2,160,518 | 2,403,041 | 2,261,285 |
| Domestic.....percent | 18 | 16 | 17 | 16 | 15 | 16 |
| Commercial.....do | 6 | 5 | 5 | 5 | 5 | 5 |
| Industrial.....do | 76 | 79 | 78 | 79 | 80 | 79 |

[1] Subject to revision.
[2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.

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*Summary of statistics for natural gas in the United States, 1933–38*—Continued

| | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|
| Number of consumers: | | | | | | |
| Domestic—thousands | 6,691 | 6,984 | 7,391 | 8,017 | 8,348 | [4] |
| Commercial—do | 541 | 582 | 613 | 657 | 680 | [4] |
| Industrial [5]—do | 30 | 31 | 36 | 39 | 39 | [4] |
| Number of producing gas wells | 53,660 | 54,130 | 53,790 | [6] 54,500 | 55,370 | [4] |
| Value (at wells) of gas produced: | | | | | | |
| Total—thousands of dollars | 97,096 | 106,438 | 110,402 | 119,193 | 123,457 | 110,887 |
| Average per M cubic feet—cents | 6.2 | 6.0 | 5.8 | 5.5 | 5.1 | 4.9 |
| Value (at point of consumption) of gas consumed: | | | | | | |
| Domestic—thousands of dollars | 209,699 | 215,029 | 233,940 | 251,617 | 273,577 | 267,880 |
| Commercial—do | 42,582 | 45,287 | 49,386 | 53,693 | 57,161 | 55,860 |
| Industrial—do | 115,838 | 133,941 | 144,748 | 170,129 | 196,791 | 176,748 |
| Total value—do | 368,119 | 394,257 | 428,074 | 475,439 | 527,529 | 500,488 |
| Average per M cubic feet: | | | | | | |
| Domestic—cents | 74.0 | 74.6 | 74.6 | 73.3 | 73.6 | 74.0 |
| Commercial—do | 49.8 | 49.6 | 49.3 | 48.1 | 48.7 | 49.0 |
| Industrial—do | 9.8 | 9.7 | 9.7 | 10.0 | 10.3 | 9.9 |
| Domestic and commercial—do | 68.4 | 68.6 | 68.5 | 67.1 | 67.6 | 68.0 |
| Domestic, commercial, and industrial—cents | 23.7 | 22.3 | 22.4 | 22.0 | 22.0 | 22.1 |
| Treated for natural gasoline: | | | | | | |
| Quantity—millions of cubic feet | 1,551,464 | 1,776,172 | 1,822,000 | 1,815,000 | 2,108,800 | 2,115,000 |
| Percent of total consumption | 100 | [7] 101 | 95 | 84 | 88 | 94 |

[4] Figures not yet available.
[5] Exclusive of oil- and gas-field operators.
[6] Revised figures.
[7] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is blown to the air and not included in total consumption.

Exports of natural gas to Mexico reached a peak of 7,350,000,000 cubic feet in 1936 but declined sharply to an estimated total of 2,000,000,000 in 1938. The Mexican Government requires the use of increasing percentages of gas produced in Mexico, when available, hence production developed south of the Rio Grande River has been replacing large quantities of gas formerly produced in Texas and piped across the international boundary. Exports to Canada of natural gas (mixed with manufactured gas) rose 15 percent in 1938 to 90,000,000 cubic feet; imports from Canada, which come from a single well on the Imperial dome north of Montana, increased to about 375,000,000 cubic feet in 1938 from 289,000,000 in 1937.

## LEGISLATION

A Federal law to regulate interstate transportation of natural gas was passed by Congress and approved on June 21, 1938. It marks the entrance of the Federal Government into the field of gas distribution as a supervisory agency. The Federal Power Commission has the responsibility of administering the act, whose purpose is to supplement the regulatory functions of State and municipal authorities. Heretofore, geographical boundaries have limited the regulatory powers of State and local governments.

The law provides for determination and enforcement of "fair" charges by the pipe-line companies for interstate transportation of natural gas and of reasonable wholesale rates for the sale of gas at "city gates." The Commission also has power to control the construction and abandonment of all interstate gas lines, to prescribe uniform systems of accounts, and to license private parties to export gas to foreign countries.

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Several important cases are now pending before the Commission relevant to its jurisdiction over construction of new gas lines and rates.

## EMPLOYMENT AND PRODUCTIVITY

The following table is not comparable with a similar table published in the Minerals Yearbook 1938, page 910. Labor employed is expressed in man-hours rather than in number of wage earners. This method affords a more accurate measure of labor effort, because many of the men who operate gas wells work on a part-time basis. In the former table natural-gas production represented the gas marketed from both gas and oil wells. Information is now available on which an approximate separation of the two types of production can be made. Therefore the current table includes the gas produced from gas wells only, from which the relationship between the volume of output and the amount of labor required at gas wells is obtained directly.

*Employment at gas wells, natural gas produced from gas wells, and average output per man-hour in the United States, 1936–37, by States*

| State | Average number of workers | | Total man-hours (thousands) | | "Dry"-gas production (millions of cubic feet) | | Labor productivity (thousands of cubic feet per man-hour) | |
|---|---|---|---|---|---|---|---|---|
| | 1936 | 1937 | 1936 | 1937 | 1936 | 1937 | 1936 | 1937 |
| Arkansas | 37 | 35 | 82 | 73 | 3,950 | 5,700 | 48.2 | 78.1 |
| California | 9 | 18 | 18 | 36 | 8,000 | 14,000 | 444.4 | 388.9 |
| Colorado | 7 | 9 | 16 | 19 | 3,600 | 3,050 | 225.0 | 160.5 |
| Illinois | 6 | 9 | 11 | 15 | 40 | 30 | 3.6 | 2.0 |
| Indiana | 102 | 97 | 135 | 164 | 2,350 | 1,700 | 17.4 | 10.4 |
| Kansas | 438 | 566 | 805 | 1,062 | 54,000 | 57,000 | 67.1 | 53.7 |
| Kentucky | 433 | 400 | 687 | 775 | 44,000 | 55,500 | 64.0 | 71.6 |
| Louisiana | 235 | 230 | 438 | 411 | 270,000 | 290,000 | 616.4 | 705.6 |
| Michigan | 52 | 60 | 78 | 109 | 5,200 | 7,900 | 66.7 | 72.5 |
| Montana | 89 | 104 | 188 | 240 | 23,100 | 24,600 | 122.9 | 102.5 |
| New Mexico | 7 | 10 | 15 | 22 | 18,400 | 26,000 | 1,226.7 | 1,181.8 |
| New York | 397 | 530 | 745 | 989 | 13,400 | 21,900 | 18.0 | 22.1 |
| Ohio | 1,209 | 1,030 | 2,092 | 1,894 | 46,800 | 42,300 | 22.4 | 22.3 |
| Oklahoma | 473 | 530 | 838 | 965 | 113,000 | 112,000 | 134.8 | 116.1 |
| Pennsylvania | 2,182 | 2,220 | 4,452 | 4,413 | 108,000 | 113,200 | 24.3 | 25.7 |
| Texas | 477 | 450 | 913 | 837 | 600,000 | 650,000 | 657.2 | 776.6 |
| West Virginia | 2,144 | 2,700 | 4,538 | 5,100 | 132,000 | 148,500 | 29.1 | 29.1 |
| Wyoming | 28 | 35 | 48 | 55 | 24,000 | 23,000 | 500.0 | 418.2 |
| Other States [1] | 35 | 40 | 61 | 66 | 13,755 | 17,400 | 225.5 | 263.6 |
| Total United States | 8,360 | 9,073 | 16,160 | 17,245 | 1,483,595 | 1,613,780 | 91.8 | 93.6 |

[1] Mississippi, Missouri, South Dakota, Tennessee, Utah, and Washington.

Employment at gas wells in the older developed areas is stable under ordinary conditions. Total employment (man-hours) was 7 percent greater in 1937 than in 1936, but most of the gain occurred in West Virginia and Kansas where many new gas wells were drilled and connected to pipe lines. Employment in "dry"-gas fields in California, although small, increased 100 percent in 1937 over 1936 as a result of the growing volume of production from several recently developed fields.

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It will be noted that the productivity of labor varies widely in different producing States. From a long-term standpoint the controlling factor in cost of labor per unit volume produced is the character of the production. Of course, changes in labor productivity in successive years are influenced by many variable factors, chief among which is probably the current demand for gas. Significant trends in labor productivity cannot be inferred from the data presented until such figures are available for a period of several years.

## GROSS PRODUCTION

The estimates of gross production of natural gas in 1936 and 1937, shown in the following table, have been compiled in a manner similar to those for 1935 published in the Minerals Yearbook, 1937, page 1060. The total production shown for each State is the sum of the quantities of gas marketed for domestic, commercial, and industrial uses plus gas reported as used in oil-field repressuring operations, stored in natural underground reservoirs, and estimated quantities lost or wasted except waste at wellheads.

The output of gas from oil wells has increased rapidly in Kansas, Louisiana, New Mexico, and Oklahoma in recent years. Such production was about 278 billion cubic feet in 1935 and 493 billion in 1937, an increase of 77 percent. In the same period estimated losses and wastage increased nearly 300 percent, or from 51 to 202 billion cubic feet. In Texas, although casinghead-gas production increased moderately, total waste declined because of restrictions placed upon "stripper" operations.

Reports of gas used for repressuring are incomplete in some States, but a trend toward the utilization of more gas for this purpose is evident in most active areas. The total volume increased about 16 percent in 1937 over 1936. Montana and New Mexico were added to the list of States reporting repressuring operations, and increases were indicated in eight other States, Texas, Oklahoma, and Louisiana being the most conspicuous.

The storage of gas in old reservoirs for future use is a minor factor in gas distribution. However, in Kansas and Ohio it is being done on a rather large scale. Gas companies are not often so situated as to profit by this practice, as many variable aspects of supply and demand must be favorable. Therefore it does not seem to offer great promise as a conservation measure.

Part of the increased loss and waste cited above was due to greater shrinkage at gasoline-extraction plants and to more complete reporting of waste in later years. However, it is clear that even with the pronounced improvement in operating technique the exploitation of oil deposits is still wasteful of gas. If the loss in volume incident to removal of natural gasoline is excluded probably more than 80 percent of the total waste of gas in the United States is due to inefficient practices in oil production.

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*Gross production of natural gas in the United States, 1936–37, by States*

[Millions of cubic feet]

| State | Estimated production [1] | | | Estimated disposition | | | |
|---|---|---|---|---|---|---|---|
| | From gas wells | From oil wells | Total | Marketed production | Repressuring | Stored in ground | Losses and wastage [2] |
| 1936 | | | | | | | |
| Arkansas | 3,950 | 6,050 | 10,000 | 8,500 | 773 | | 727 |
| California | 8,000 | 382,000 | 390,000 | 320,406 | 33,176 | 1,377 | 35,041 |
| Colorado | 3,600 | 350 | 3,950 | 3,687 | | | 263 |
| Illinois | 40 | 980 | 1,020 | 865 | | | 155 |
| Indiana | 2,350 | 150 | 2,500 | 2,241 | 1 | | 258 |
| Kansas | 54,000 | 29,400 | 83,400 | 69,178 | 1,220 | [3] 2,100 | 12,561 |
| Kentucky | 44,000 | 4,000 | 48,000 | 43,903 | 850 | | 3,247 |
| Louisiana | 270,000 | 50,000 | 320,000 | 290,151 | 2,584 | | 27,265 |
| Michigan | 5,200 | 2,400 | 7,600 | 7,167 | | | 433 |
| Mississippi | 13,000 | | 13,000 | 11,821 | | | 1,179 |
| Missouri | 405 | 10 | 415 | 399 | | | 16 |
| Montana | 23,100 | 900 | 24,000 | 23,003 | | | 997 |
| New Mexico | 18,400 | 29,600 | 48,000 | 33,928 | | 4,225 | 9,847 |
| New York | 13,400 | 100 | 13,500 | 12,431 | | | 1,069 |
| Ohio | 46,800 | 3,200 | 50,000 | 46,994 | 100 | 1,309 | 1,597 |
| Oklahoma | 113,000 | 267,000 | 380,000 | 280,481 | 22,519 | 574 | 75,680 |
| Pennsylvania | 108,000 | 7,000 | 115,000 | 110,362 | 307 | 68 | 4,263 |
| Texas | 600,000 | 350,000 | 950,000 | 734,561 | 2,753 | 520 | 211,253 |
| West Virginia | 132,000 | 14,000 | 146,000 | 138,076 | 1,724 | 825 | 5,375 |
| Wyoming | 24,000 | 14,100 | 38,100 | 29,322 | 7,500 | | 1,278 |
| Other States [4] | 350 | | 350 | 326 | | | 24 |
| | 1,483,595 | 1,161,240 | 2,644,835 | 2,167,802 | 73,507 | 10,998 | 392,528 |
| 1937 | | | | | | | |
| Arkansas | 5,700 | 6,800 | 12,500 | 9,690 | 220 | | 2,590 |
| California | 14,000 | 386,000 | 400,000 | 329,769 | 34,120 | 1,589 | 34,522 |
| Colorado | 3,050 | 250 | 3,300 | 3,186 | | | 114 |
| Illinois | 30 | 1,170 | 1,200 | 1,040 | | | 160 |
| Indiana | 1,700 | 100 | 1,800 | 1,551 | 1 | | 248 |
| Kansas | 57,000 | 48,700 | 105,700 | 83,890 | 1,260 | [5] 5,358 | 19,485 |
| Kentucky | 55,500 | 5,000 | 60,500 | 55,719 | 1,000 | 51 | 3,199 |
| Louisiana | 290,000 | 70,000 | 360,000 | 315,301 | 3,922 | | 40,777 |
| Michigan | 7,900 | 1,500 | 9,400 | 9,080 | | | 320 |
| Mississippi | 14,300 | | 14,300 | 13,348 | | | 952 |
| Missouri | 460 | 10 | 470 | 444 | | | 26 |
| Montana | 24,600 | 900 | 25,500 | 24,765 | 195 | | 540 |
| New Mexico | 26,000 | 46,000 | 72,000 | 46,337 | 1,087 | | 24,576 |
| New York | 21,900 | 100 | 22,000 | 21,325 | | 4 | 671 |
| Ohio | 42,300 | 3,200 | 45,500 | 42,783 | 6 | [6] 5,010 | 1,183 |
| Oklahoma | 112,000 | 328,000 | 440,000 | 296,260 | 24,624 | 56 | 116,806 |
| Pennsylvania | 113,200 | 6,800 | 120,000 | 115,928 | 293 | 770 | 3,009 |
| Texas | 650,000 | 390,000 | 1,040,000 | 854,561 | 6,734 | | 176,666 |
| West Virginia | 143,500 | 14,500 | 163,000 | 149,084 | 3,870 | 868 | 6,227 |
| Wyoming | 23,000 | 16,600 | 39,600 | 31,023 | 7,593 | | 984 |
| Other States [4] | 2,640 | | 2,640 | 2,536 | | | 104 |
| | 1,613,780 | 1,325,630 | 2,939,410 | 2,407,620 | 84,925 | 13,706 | 433,159 |

[1] Marketed production plus quantities used in repressuring, stored in the ground, lost in handling, and blown to the air.

[2] Includes gas blown to the air, shrinkage at natural-gasoline plants, and transportation losses but does not include wastage at wellheads.

[3] Produced approximately as follows: 953 million cubic feet in Texas, 746 million in Oklahoma, 401 million in Kansas.

[4] South Dakota, Tennessee, Utah, and Washington.

[5] Produced approximately as follows: 2,071 million cubic feet in Texas, 2,254 million in Oklahoma, 1,033 million in Kansas.

[6] Produced approximately as follows: 2,951 million cubic feet in West Virginia, 531 million in Kentucky, 1,528 million in Ohio.

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## MARKETED PRODUCTION

The 6-percent decline in total marketed production in 1938 (to 2,263,000 million cubic feet from 2,407,620 million in 1937) was caused chiefly by smaller demand for most industrial uses. Output declined in all States except New York, Illinois, and New Mexico in 1938. In 1937 marketed production reached an all-time peak in Kansas, Kentucky, Louisiana, Michigan, Mississippi, Montana, New Mexico, New York, and Texas.

The volume marketed from Texas fields in 1938 almost equaled that in 1937. In contrast, output declined materially in other leading producing States. Texas production has grown from 31 percent of the national total in 1933 to 37 percent in 1938. Total marketed production of the five leading States represented 82 percent of the United States total in 1933 and 81 percent in 1938.

The average value of gas at the wells increased in 1937 over 1936 in seven States, notably Louisiana, Michigan, and Wyoming. It declined substantially in Missouri, New York, Pennsylvania, and West Virginia.

*Natural gas produced in the United States and delivered to consumers, 1933–37, by States, in millions of cubic feet*

| Year | Arkansas | California | Colorado | Illinois | Indiana | Kansas | Kentucky | Louisiana | Michigan | Mississippi | Montana | New Mexico |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1933 | 8,288 | 259,799 | 2,449 | 1,631 | 1,544 | 41,596 | 31,380 | 197,826 | 1,528 | 8,679 | 14,391 | 19,148 |
| 1934 | 7,024 | 268,122 | 2,633 | 1,868 | 1,802 | 46,909 | 33,124 | 225,713 | 2,789 | 8,245 | 14,971 | 24,075 |
| 1935 | 6,167 | 284,109 | 2,843 | 1,448 | 1,777 | 57,125 | 39,738 | 249,450 | 4,203 | 9,643 | 19,870 | 27,931 |
| 1936 | 8,500 | 320,406 | 3,687 | 865 | 2,241 | 69,178 | 43,903 | 290,151 | 7,167 | 11,821 | 23,003 | 33,928 |
| 1937 | 9,690 | 329,769 | 3,186 | 1,040 | 1,551 | 83,890 | 55,719 | 315,301 | 9,080 | 13,348 | 24,765 | 46,337 |

| Year | New York | Ohio | Oklahoma | Pennsylvania | Texas | West Virginia | Wyoming | Other States | Total | Value at points of consumption | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total (thousands of dollars) | Average per M cubic feet (cents) |
| 1933 | 6,865 | 47,929 | 245,759 | 63,579 | 475,691 | 100,653 | 25,830 | 909 | 1,555,474 | 368,540 | 23.7 |
| 1934 | 6,278 | 50,330 | 254,457 | 86,238 | 602,976 | 109,161 | 23,148 | 858 | 1,770,721 | 395,378 | 22.3 |
| 1935 | 8,288 | 49,592 | 274,313 | 94,464 | 642,366 | 115,772 | 26,643 | 853 | 1,916,595 | 429,374 | 22.4 |
| 1936 | 12,431 | 46,994 | 280,481 | 110,362 | 734,561 | 138,076 | 29,322 | 725 | 2,167,802 | 476,813 | 22.0 |
| 1937 | 21,325 | 42,783 | 296,260 | 115,928 | 854,561 | 149,084 | 31,023 | 2,980 | 2,407,620 | 528,354 | 21.9 |

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*Natural gas produced and consumed in the United States in 1937, by States*

| State | Produced and delivered to consumers, including deliveries in other States | | | | | | Consumed, including receipts from other States | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | | Estimated value at the wells | | Value at points of consumption | | Quantity | | Value at points of consumption | |
| | M cubic feet | Percent of total | Total | Average per M cubic feet (cents) | Total | Average per M cubic feet (cents) | M cubic feet | Percent of total | Total | Average per M cubic feet (cents) |
| Ala | | | | | | | 16,593,000 | 0.7 | $4,163,000 | 25.1 |
| Ariz | | | | | | | 12,857,000 | .5 | 3,816,000 | 29.7 |
| Ark | 9,690,000 | 0.4 | $637,000 | 6.6 | $1,984,000 | 20.5 | 35,074,000 | 1.5 | 7,182,000 | 20.5 |
| Calif | 329,769,000 | 13.7 | 21,699,000 | 6.6 | 91,089,000 | 27.6 | 329,769,000 | 13.7 | 91,089,000 | 27.6 |
| Colo | 3,186,000 | .1 | 105,000 | 3.3 | 673,000 | 21.1 | 20,816,000 | .9 | 7,032,000 | 33.8 |
| D. C | | | | | | | 3,458,000 | .1 | 2,527,000 | 73.1 |
| Fla | | | | | | | 1,389,000 | .1 | 366,000 | 26.3 |
| Ga | | | | | | | 13,893,000 | .6 | 5,546,000 | 39.9 |
| Ill | 1,040,000 | (1) | 84,000 | 8.1 | 533,000 | 51.3 | 78,650,000 | 3.3 | 38,155,000 | 48.5 |
| Ind | 1,551,000 | .1 | 227,000 | 14.6 | 996,000 | 64.2 | 23,551,000 | 1.0 | 6,821,000 | 29.0 |
| Iowa | | | | | | | 21,354,000 | .9 | 7,256,000 | 34.0 |
| Kans | 83,890,000 | 3.5 | 3,565,000 | 4.2 | 30,376,000 | 36.2 | 96,822,000 | 4.0 | 20,598,000 | 21.3 |
| Ky | 55,719,000 | 2.3 | 6,770,000 | 12.2 | 22,904,000 | 41.1 | 18,154,000 | .7 | 7,560,000 | 41.6 |
| La | 315,301,000 | 13.1 | 10,846,000 | 3.4 | 53,908,000 | 17.1 | 174,153,000 | 7.2 | 21,270,000 | 12.2 |
| Md | | | | | | | 1,011,000 | (1) | 784,000 | 77.5 |
| Mich | 9,080,000 | .4 | 871,000 | 9.6 | 5,640,000 | 62.1 | 24,112,000 | 1.0 | 22,583,000 | 93.7 |
| Minn | | | | | | | 13,111,000 | .5 | 6,427,000 | 49.0 |
| Miss | 13,348,000 | .6 | 577,000 | 4.3 | 3,041,000 | 22.8 | 13,327,000 | .6 | 3,549,000 | 26.6 |
| Mo | 444,000 | (1) | 38,000 | 8.6 | 226,000 | 50.9 | 46,898,000 | 2.0 | 17,550,000 | 37.4 |
| Mont | 24,765,000 | 1.0 | 924,000 | 3.7 | 6,667,000 | 26.9 | [2] 21,594,000 | .9 | 5,333,000 | 24.7 |
| Nebr | | | | | | | 17,263,000 | .7 | 6,367,000 | 36.9 |
| N. Mex | [3] 46,337,000 | 1.9 | 714,000 | 1.5 | 7,699,000 | 16.6 | 28,056,000 | 1.2 | 3,088,000 | 11.0 |
| N. Y | [4] 21,325,000 | .9 | 3,408,000 | 16.0 | 12,388,000 | 58.1 | 50,080,000 | 2.1 | 20,299,000 | 40.5 |
| N. Dak | | | | | | | 1,641,000 | .1 | 620,000 | 37.8 |
| Ohio | 42,783,000 | 1.8 | 6,854,000 | 16.0 | 19,967,000 | 46.7 | 125,133,000 | 5.2 | 58,574,000 | 46.8 |
| Okla | 296,260,000 | 12.3 | 6,127,000 | 2.1 | 32,039,000 | 10.8 | 269,604,000 | 11.2 | 22,215,000 | 8.2 |
| Pa | [5] 115,928,000 | 4.8 | 20,206,000 | 17.4 | 41,842,000 | 36.1 | 119,501,000 | 5.0 | 47,537,000 | 39.8 |
| S. Dak | 10,000 | (1) | 1,000 | 10.0 | 3,000 | 30.0 | 5,519,000 | .2 | 1,892,000 | 34.3 |
| Tenn | 17,000 | (1) | 1,000 | 5.9 | 6,000 | 35.3 | 13,353,000 | .6 | 4,334,000 | 32.5 |
| Tex | [6] 854,561,000 | 35.5 | 19,399,000 | 2.3 | 132,166,000 | 15.5 | 706,120,000 | 29.4 | 59,751,000 | 8.5 |
| Utah | 2,366,000 | .1 | 79,000 | 3.3 | 471,000 | 19.9 | 12,449,000 | .5 | 2,513,000 | 20.2 |
| Va | | | | | | | 550,000 | (1) | 539,000 | 98.0 |
| Wash | 143,000 | (1) | 11,000 | 7.7 | 100,000 | 69.9 | 143,000 | (1) | 100,000 | 69.9 |
| W. Va | 149,084,000 | 6.2 | 19,306,000 | 12.9 | 58,639,000 | 39.3 | 65,395,000 | 2.7 | 17,289,000 | 26.4 |
| Wyo | 31,023,000 | 1.3 | 1,008,000 | 3.2 | 4,997,000 | 16.1 | 21,648,000 | .9 | 2,804,000 | 13.0 |
| Total: 1937 | 2,407,620,000 | 100.0 | 123,457,000 | 5.1 | 528,354,000 | 21.9 | 2,403,041,000 | 100.0 | 527,529,000 | 22.0 |
| 1936 | 2,167,802,000 | 100.0 | 119,193,000 | 5.5 | 476,813,000 | 22.0 | 2,160,518,000 | 100.0 | 475,439,000 | 22.0 |

[1] Less than 0.05 percent.
[2] Includes 289,000 M cubic feet piped from Canada.
[3] Includes 867,000 M cubic feet piped to Mexico.
[4] Includes 29,000 M cubic feet piped to Canada.
[5] Includes 49,000 M cubic feet piped to Canada.
[6] Includes 3,923,000 M cubic feet piped to Mexico.

## WELLS

Development was curtailed in most active sectors in 1938, total gas completions being 2,236, about 21 percent less than in 1937. The influence of slightly reduced market requirements and the existence in many important fields of developed capacity in excess of current requirements of the pipe lines lessened materially the need for new wells. Therefore, a large percentage of the gas completions during 1938 were drilled because of lease obligations or in connection with oil exploration. Active exploitation proceeded in a few highly competitive flush areas, such as the Oriskany fields near Charleston, W. Va.; Allegany and Steuben Counties, N. Y.; and the smaller new fields in Lawrence County, Ill., and Jackson County, Mo.

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In Illinois, Indiana, Mississippi, Missouri, Oklahoma, and Wyoming the number of gas completions was somewhat larger in 1938 than in 1937. Declines were general elsewhere; the most conspicuous were in Kansas, Kentucky, Michigan, Texas, and West Virginia.

As shown in the accompanying table the number of gas wells producing as of December 31, 1937, was 55,370 compared with 54,500 a year earlier. Subtraction of the net increase of 870 producing wells from the 2,834 wells drilled during 1937 indicates that 1,964 gas wells were abandoned in that year.

The number of producing gas wells in Texas at the close of 1936 and 1937 has been adjusted to conform to records of the Railroad Commission of Texas.

*Gas wells in the United States, 1936–38*

| State | Number of producing gas wells, Dec. 31, 1936 | Number of gas wells drilled during 1937 [1] | Number of producing gas wells, Dec. 31, 1937 | Number of gas wells drilled during 1938 [1] |
|---|---|---|---|---|
| Arkansas | 180 | 6 | 190 | 3 |
| California | 40 | 17 | 60 | 7 |
| Colorado | 20 | 2 | 20 | 1 |
| Illinois | 70 | 3 | 70 | 23 |
| Indiana | 960 | 39 | 970 | 43 |
| Kansas | 2,630 | 357 | 2,500 | 200 |
| Kentucky | [2] 2,380 | 193 | [2] 2,510 | 91 |
| Louisiana | 1,490 | 148 | 1,600 | 126 |
| Michigan | 290 | 69 | 350 | 28 |
| Mississippi | 110 | 3 | 90 | 6 |
| Missouri | 130 | 49 | 150 | 60 |
| Montana | 360 | 26 | 380 | 21 |
| New Mexico | 50 | 27 | 70 | 19 |
| New York | 2,040 | [3] | 2,090 | [3] |
| Ohio | 6,350 | 497 | 6,340 | 433 |
| Oklahoma | 2,610 | 123 | 2,630 | 160 |
| Pennsylvania | 19,150 | [3] 186 | 19,130 | [3] 166 |
| Tennessee | [2] | | [2] | |
| Texas | [4] 2,720 | 425 | 3,260 | 341 |
| Utah, Washington, and South Dakota | 30 | 2 | 30 | 5 |
| West Virginia | 12,770 | 650 | 12,800 | 484 |
| Wyoming | 120 | 12 | 130 | 19 |
| | [4] 54,500 | 2,834 | 55,370 | 2,236 |

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.
[3] New York included with Pennsylvania.
[4] Revised figures.

## REVIEW OF FIELD DEVELOPMENTS, BY STATES

*Arkansas.*—Gross production of natural gas in Arkansas increased 65 percent to 20,557 million cubic feet in 1938 compared with 12,485 million cubic feet in 1937, according to information received from George C. Branner, State geologist.

The principal increase was in Miller County, where gas production totaled 11.1 billion cubic feet in 1938 and only 1.4 billion in 1937. Most of the Miller County gas came from new oil wells with high gas-oil ratios in the Rodessa extension. Gas output was larger in 1938 than in 1937 in Union, Sebastian, Pope, and Nevada Counties but declined substantially in Crawford, Johnson, Ouachita, and Franklin Counties. Columbia and Lafayette were added to the list of counties reporting production of natural gas in 1938.

Only three gas-well completions were reported in 1938. The No. 1 Bryan & Khilling (sec. 22, T. 8 N., R. 29 W.), in Franklin County

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made 1.9 million cubic feet per day from 2,600 feet. In Johnson County the No. 2 Hudson (sec. 14, T. 10 N., R. 24 W.) was completed with an initial capacity of 40 million cubic feet per day and rock pressure of 1,300 pounds from a depth of 3,401 feet. The No. 1 Raulston (sec. 12, T. 17 S., R. 14 W.), Union County, was completed with a capacity of 1.5 million cubic feet per day from 3,184 feet and a rock pressure of 1,100 pounds. In Miller County the No. B–2 Thomas (sec. 12, T. 20 S., R. 28 W.) made 12 million cubic feet per day of gas and 50 barrels of oil. Forty other completions in Miller County increased considerably the available reserves of casinghead gas. Three oil discoveries in Columbia County also added to current supplies of casinghead gas.

Gas pipe-line construction in Arkansas in 1938 was limited to one 6-inch line running from the Schuler field, Union County, to El Dorado, a distance of 18 miles.

*California.*—Although the marketed production of natural gas in California is estimated to have declined 4 percent in 1938 from 1937, gross production probably increased from 357 billion cubic feet in 1937 to 365 billion in 1938. Total gas processed for natural-gasoline extraction increased about 2 percent to 388 billion cubic feet, including 60 billion or more "recycled" back to the oil sands.

Production from "dry" gas fields, which represents only a small fraction of the total gas production in California, was probably somewhat larger in 1938 than in 1937. Gas wells often are shut in during the summer and allowed to produce into the pipe lines during the winter when demand for gas expands.

Drilling in the gas fields is retarded at present by the fact that productive capacity is larger than immediate needs for gas. Nine wells were completed in old fields in 1938 and 16 in 1937. The only active development was in the Rio Vista gas field, where eight of the completions were reported, extending the proved area eastward from Solano into Sacramento County. The other gas well was drilled at McDonald Island and increased the number of producers in that field to seven.

In addition, two gas discoveries were made in 1938. In Willow district, Glenn County, more than 100 miles north of San Francisco, a gas blow-out occurred at the Williard No. 1 on January 8, 1938. The reported flow of 75 million cubic feet per day wrecked the rig. A second well was drilled to 6,014 feet and, when plugged back to 2,364 feet, made 6 million cubic feet of gas. The value of the discovery is still in doubt.

The Potrero Hills No. 1, a wildcat in Solano County, was completed in December 1938 for 5 million cubic feet of gas from a depth of 3,238 feet, apparently opening up a new area for gas production.

Several oil discoveries were made in 1938 which indicated large additions to the available reserves of casinghead gas. Among these were Southeast Coalinga in Fresno County; Tupman, Coles Levee, Wasco, and Greeley (deep zone) in Kern County; and Montebello (deep zone), Wilmington, and Long Beach in Los Angeles County.

Development of gas production in recent years in the regions east and north of San Francisco Bay is providing supplies of natural gas for new market areas in the northern part of the State that hitherto have been inaccessible to natural-gas service.

Gas pipe-line construction was very small. An 8-inch line 14 miles long was built from Merced, Merced County, through Atwater to

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Livingston. In the Montebello oil field 10 miles of 10-inch line were laid to carry casinghead gas.

*Colorado.*—The only changes in the natural-gas industry in Colorado during 1938 were in rates of production from the various fields, which generally decreased. The following data have been supplied by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo.

Total gas production was 1,487 million cubic feet, a decline of 45 percent from 1937. Output of the Hiawatha field (Colorado portion), the principal gas source within the State, was 1,301 million cubic feet, almost 50 percent less than in 1937. The Garcia field with 54 million cubic feet and the Craig field with 4 million cubic feet also produced substantially less gas in 1938. Small increases were recorded from the Thornburg and Berthoud fields, which produced 72 and 55 million cubic feet, respectively, of the total marketed output in 1938.

Gas from the Hiawatha field is consumed in Salt Lake City, Utah, and that from the other producing fields is utilized in Colorado for domestic and commercial purposes.

Waste of gas from gas fields was very small. Approximately 14 million cubic feet of gas were blown to the air from the recently discovered Wilson Creek oil field. The Garmesa, Piceance Creek, Powder Wash, and White River fields remained shut in for lack of a market.

*Illinois.*—The most important natural-gas development in Illinois in 1938 was the discovery of a large volume of gas in Lawrence County. Information is taken from a report by Alfred H. Bell and George V. Cohee, Illinois State Geological Survey.

Two small gas wells were drilled in 1937 in sec. 30, T. 5 N., R. 10 W., Lawrence County, producing from a Pennsylvanian sand at about 620 feet. In July 1938 the Scott Gray No. 1 (sec. 13, T. 4 N., R. 11 W.) obtained gas in the Buchanan sandstone at a depth of 1,061 feet and was completed with an initial capacity of 16 million cubic feet per day. Thirteen producing wells were drilled in the field in 1938 with an average capacity of 14 million cubic feet per well. The proved area in both fields was about 500 acres at the end of the year. Deeper potential oil- and gas-producing formations have not yet been tested. The heating value of the gas is about 950 B. t. u. per cubic foot. It comprises methane with minor amounts of ethane, carbon dioxide, and nitrogen.

The Ayers gas field in Bond County produced 23.2 million cubic feet of gas in 1938, which brought its cumulative production to 167 million cubic feet from a productive area of 325 acres. Of the 19 wells drilled in the field, 10 are still producing. The heating value of the gas is 1,050 B. t. u. per cubic foot.

A small quantity of natural gas is being produced with oil in many of the new oil fields in Illinois. Some gas is being returned to the producing sands in the Louden (Beecher City) field, and a similar project has been started in the Salem (Lake Centralia) field. Gas is used in field operations, and some is processed for extraction of natural gasoline. The excess gas is burned in flares.

A 3-inch pipe line which had been built in 1937 from sec. 30, T. 5 N., R. 10 W., Lawrence County, to Oaktown, Ind., was replaced in 1938 with a 6-inch line, and two 4-inch gathering lines were laid to the Buchanan sand field a short distance southwest.

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*Indiana.*—Gas-well completions in Indiana in 1938 numbered 41 compared with 34 in 1937. Exploration for gas and oil was stimulated by the successful operations in Illinois, and an active leasing campaign was started in southwestern Indiana.

Two gas discoveries were reported, the No. 1 Ogle (sec. 35, T. 8 N., R. 10 W.), Sullivan County, being the more important. This well made 2 million cubic feet of gas per day from a stray sand in the Pennsylvanian series at a depth of 821 feet. The other discovery was the No. 1 Bobrink (sec. 15., T. 6 N., R. 1 W.), Dearborn County, which was completed at a depth of 450 feet with an initial capacity of 300,000 cubic feet of gas per day. The Oaktown field in Knox County was extended during 1938 by completion of new wells producing from Pennsylvanian sands.

Indiana produced 1,551 million cubic feet of natural gas in 1937 and probably a larger quantity in 1938.

A new 6-inch line was laid in 1938 to bring gas from recently developed gas fields in Lawrence County, Ill., to supplement the supply of a line in the Oaktown field.

*Kansas.*—Compared with 1937 there was a considerable decrease in 1938 both in total number of gas wells drilled and new pools opened in Kansas, according to a report by Raymond P. Keroher, geologist, Kansas Geological Survey. In western Kansas, 75 gas wells were completed, 25 of which also produced oil in commercial quantities. Only one of these was a discovery well. In eastern Kansas only four gas wells were reported, although many more were drilled.

The single discovery, No. 1 Young (sec. 34, T. 27 S., R. 21 W.), was completed June 13 at 5,037 feet in Mississippi lime, after having been plugged back from 5,930 feet in the Arbuckle. After treatment with 14,000 gallons of acid the well made 6 million cubic feet of gas, 48 barrels of oil, and 200 barrels of water initially. The field opened by this well, which is 50 miles from the nearest commercial oil production and the only one in Ford County, was officially named the Pleasant Valley field.

The greatest gas activity in western Kansas in 1938 was in Barber, Grant, Kearney, Reno, Rice, Stafford, and Stevens Counties. Fewer gas wells were drilled in Ellsworth, Harvey, Kingman, McPherson, Pratt, and Russell Counties.

Eight wells were added to the Medicine Lodge gas field in T. 33 S., R. 13 W., Barber County, during 1938. Their average potential was 11 million cubic feet from the Mississippi lime at depths of 4,630 to 5,045 feet.

The Hugoton field of Grant and Stevens Counties was again the most active locality in the State. Fifteen wells were completed in Stevens County with an average initial capacity of about 9 million cubic feet of gas per well, and eight were completed in Grant County with an average of 11 million cubic feet. The gas at Hugoton is obtained from rocks of the Chase and Sumner groups of Permian age at depths of about 2,600 to 2,900 feet.

In the Holcomb field (T. 25 S., R. 35 W.), Kearney County, six wells of comparable capacity and depth were completed in the same reservoir formations. Two large gas wells of 65 and 68 million cubic feet capacity were drilled in the Cunningham pool of Pratt and Kingman Counties. Production is from the Viola lime at 3,950 and 4,292 feet.

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In Reno County, a 1.5-million cubic-foot well was completed in the Lerado field, and two were completed in the Yoder field with total capacity of 17.5 million cubic feet. One gas well and several oil wells with high gas-oil ratios were drilled in the Burrton field.

Four wells were drilled in the Lyons gas field (T. 20 S., R. 8 W.), Rice County, during 1938 with potentials ranging from 10 to 51 million cubic feet per day. One smaller gas well was completed in the Thurber field (T. 21 S., R. 7 W.) and one in the Stumps field (T. 17 and 18 S., R. 10 W.).

In McPherson County one well of 7 million cubic feet capacity was drilled in the Graber pool (T. 21 S., R. 2 W.), and two completions in the Ritz pool (T. 19 S., R. 1 and 2 W.) produced 30 and 29 million cubic feet of gas, respectively, with comparatively little oil.

Wells that produced gas in commercial quantities along with oil were reported as follows: One each in the Hall and Letsch fields of Russell County; one in the Kip field; and eight in the Zenith field of Stafford County. One well in the Sperling pool (T. 22 S., R. 2 W.), Harvey County, was completed in the Hunton lime at a depth of 3,249 feet with an initial production of 24 million cubic feet of gas and 164 barrels of oil.

In eastern Kansas a 5-million cubic-foot well was completed in the Penwest field (T. 31 S., R. 5 E.) and a well of the same size in the Tisdale field (T. 32 S., R. 5 E.), both in Cowley County. An important well was reported in the Andover field (T. 27 S., R. 3 E.), Butler County, with an initial capacity of 13.5 million cubic feet of gas and 204 barrels of oil. No adequate records of eastern Kansas development are compiled, but probably drilling was less active in 1938 than in 1937.

Reconditioning of the Craig-Zarah gas field in Johnson County for use as a storage reservoir was begun early in 1938 and continued most of the year.

*Kentucky.*—Gas development in Kentucky in 1938 was substantially less, but the volume of gas deliveries was approximately the same as in 1937, according to information in a report by C. D. Hunter, geologist, Kentucky West Virginia Gas Co., I. B. Browning, geologist and operator, and Ralph Thomas, geologist, Ashland Oil & Refining Co., all of Ashland, Ky. In eastern Kentucky not over 50 gas wells were completed, a decline of about 50 percent from 1937. Operations were curtailed because of the continued development of large volumes of Oriskany-sand gas in West Virginia and of the already developed producing capacity in eastern Kentucky which exceeds current market requirements. Average initial production of the eastern Kentucky wells was 4 to 5 hundred thousand cubic feet per day.

Gas was used for repressuring the Weir sand fields of Johnson and Magoffin Counties but only in small amounts, owing to the local scarcity of gas. The Flat Gap field, Johnson County, although nearly depleted, furnished some gas for repressuring. In Powell County the Janet field furnished some low-pressure gas to short pipe lines in Lee and Powell Counties for use as fuel and for repressuring. In a small, isolated oil field in Martin County about 150,000 cubic feet per day of casinghead gas was processed for extraction of gasoline, yielding 4 to 5 barrels daily.

In western Kentucky only 41 gas wells were drilled, distributed by counties as follows: Ohio 12, Daviess 6, Breckenridge, Grayson, and

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Hancock 5 each, Henderson 4, Webster 3, and McLean 1. Total gas completions equaled only about one-third those in 1937. Because of limited marketing facilities in the area only a small part of the gas developed can be sold, hence little effort is directed toward the discovery and development of new gas-producing areas. Most gas-well completions are the result of wells started and drilled in search of oil.

No major gas pipe-line construction was reported during the year.

*Louisiana.*—Gas-well completions in north Louisiana in 1938 declined to 137 compared to 184 in 1937, according to a report by Cyril K. Moresi, State geologist. Of this number, 59 were combination gas and distillate wells and 4 wet gas wells. In addition, the Shreveport field, discovered in July 1938, had 6 completions which produced large volumes of gas with oil from the basal Glen Rose horizon at depths of 5,500 to 5,600 feet.

The Cotton Valley field, Webster Parish, was the most active area with 59 completions, all of which were combination wells. Eighteen gas wells were drilled in the Rodessa field, Caddo Parish, in 1938, a 51-percent decline from 1937. Total open-flow capacity of the 1938 completions was 358 million cubic feet per day.

In the Monroe gas field in northeastern Louisiana 53 wells were drilled in 1938 with a total capacity of 302 million cubic feet per day. In 1937, 89 gas wells were drilled in this field. The total number of wells capable of producing gas increased during 1938 from 1,136 to 1,182. Their open-flow capacity, however, decreased from 4,648 million to 4,310 million cubic feet per day. Of the other gas fields in northeastern Louisiana, the Richland had 75 gas wells with a total capacity of 230 million cubic feet at the end of the year, Epps had 4 wells with 107 million, and Simsboro had 3 wells with 133 million.

Other gas completions were scattered in four fields in Caddo Parish, one each in De Soto, Webster, and Bienville Parishes.

Distillate was discovered in the old Shongaloo oil and gas field, Webster Parish, in June 1938. The discovery well made 2.7 million cubic feet of gas with 279 barrels of distillate from the Cotton Valley formation at 9,010 feet. Spacing of 160 acres per well has been prescribed for future developments. The Logansport field in De Soto Parish was discovered by the Parker No. 1 in June 1938. The well produced 4.3 million cubic feet of gas with 14 barrels of distillate from the Glen Rose formation at 5,187 feet.

Proration schedules of allowable gas production are in force in the Cotton Valley, Rodessa, and Shreveport fields.

Gross production from gas wells in the State in 1938 was 260 billion cubic feet, 14 percent less than in 1937. Of the total, about 7 billion cubic feet came from southern Louisiana fields and the rest from northern fields. Production from the northeastern Louisiana fields—Monroe, Richland, and Epps—declined 18 percent in 1938 to 179 billion cubic feet. Withdrawals from Rodessa gas wells dropped in 1938 to 26.5 billion cubic feet from 56.3 billion in 1937. Cotton Valley production rose sharply from 10.4 billion cubic feet in 1937 to 20 billion in 1938.

An increase of almost 100 percent was reported in casinghead-gas production. The total was 100.8 billion cubic feet in 1938 compared with 55.8 billion in 1937. The output of northern Louisiana fields rose from 17.3 to 43.4 billion cubic feet and that of the coastal fields from 38.5 to 57.1 billions. The Rodessa field produced 34.6 billion

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in 1938 and only 14.3 billion in 1937. The radical changes in volume of production reported from gas wells and oil wells at Rodessa appears to be due largely to reclassification of wells. Gas production from the field totaled 70.6 billion cubic feet in 1937 and 61.2 billion in 1938. Of the northern fields, Lisbon, Cotton Valley, and Sligo were credited with substantial increases in output of casinghead gas.

Casinghead-gas production was reported from 70 coastal Louisiana fields in 1938 and 43 in 1937. Part of the indicated increase in production in 1938 is accounted for by more complete reports than previously. The most important fields in 1938, in order of output, were Tepetate, 9.5 billion cubic feet; Roanoke, 7.1; Lafitte, 6.3; English Bayou, 5.4; Iowa, 5.0; Bosco, 3.5; and Jennings, 3.0. Roanoke production increased from 132 million cubic feet in 1937 to 7,108 million cubic feet in 1938. Important increases in output also were made at English Bayou, Jennings, Lafitte, Lake Long, and Ville Platte fields.

*Michigan.*—Reported gas production in 1938 was 9,233 million cubic feet, about 1 percent less than in 1937, according to F. R. Frye, petroleum engineer, Michigan Department of Conservation. This total includes 1,515 million cubic feet of casinghead gas, a gain of 84 million cubic feet over 1937.

Only 27 gas wells were drilled during 1938, in contrast to 66 in 1937 and 206 in 1936, and 21 were abandoned, leaving a total of 441 producing on January 1, 1939, a net increase of 6 for the year.

New producing areas were developed in Winfield (T. 12 N., R. 9 W.) and Home Townships (T. 12 N., R. 6 W.), of Montcalm County, and Grant (T. 17 N., R. 4 W.), Lincoln (T. 18 N., R. 5 W.), and Freeman Townships (T. 18 N., R. 6 W.), of Clare County. Most of these fields were connected to existing pipe lines.

Perhaps the most interesting gas discovery was in a well drilled in sec. 32, T. 23 N., R. 5 W., Enterprise Township, Missaukee County. This well encountered about 3.7 million cubic feet of gas in the Michigan Stray sand at 1,000 to 1,008 feet. The discovery is about 30 miles from the nearest production in this sand and adds a large area of possible gas-producing territory to that already known. The gas was cemented off and the well drilled deeper.

*Mississippi.*—Natural-gas production in Mississippi, as reported by H. M. Morse, State oil and gas supervisor, was 14,298 million cubic feet in 1938, a slight gain over that of 1937, the previous peak year. The Jackson field supplied the entire gas output of the State in 1938, as the depleted Amory field of Monroe County did not produce after 1937.

Salt-water encroachment in the Jackson field has become a serious problem, as indicated by the sharp reduction in the number of producing gas wells from 90 on January 1, 1938, to 59 at the end of the year. Six gas wells and one dry hole were drilled in the field during 1938.

In August 1938 one of the wells caught fire and caused an estimated waste of 300 million cubic feet of gas. A temporary tax of 7.5 percent of the output was placed upon all wells to reimburse the State for money expended to extinguish the fire. General waste of gas approximated 50 million cubic feet, making a total of 350 million cubic feet of gas wasted in 1938.

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The gas produced in Mississippi and sold to pipe lines was consumed approximately as follows: 25 percent for domestic purposes, 15 percent commercial, and 60 percent industrial. Over 40 percent of the State production, or 6,340 million cubic feet, was marketed through pipe lines in Alabama (28 percent), Florida (13 percent), and Louisiana (3 percent).

Nine wildcat wells were drilled in Mississippi in 1938, all of which were unproductive.

*Missouri.*—Drilling in Missouri increased sharply in 1938, according to a report by Frank C. Greene, geologist, Missouri Geological Survey. Of 60 gas wells completed, 56 with a total initial open-flow capacity of 52 million cubic feet were in Jackson County and 4 with 0.5 million cubic feet total capacity were in Cass County.

The most active area was the so-called Bartlesville or Sniabar "shoestring" sand field in Jackson County which was extended southeastward. It seems probable that the producing sand is at the horizon of the Burbank sand.

A new Squirrel sand gas pool was developed in secs. 30 and 31, T. 49 N., R. 32 W., Jackson County. A pipe line to take gas from this pool was completed in March 1939.

Wildcatting in Clay, Hickory, Marion, Platte, and St. Clair Counties was unsuccessful, resulting in 16 dry holes. An active leasing campaign was carried on in the "Forrest City Basin" of northern Missouri preparatory to drilling in search of new oil and gas fields.

*Montana.*—Drilling and production of natural gas in Montana proceeded at reduced rates in 1938, according to a report by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo. Twenty-one gas wells were completed in oil fields with a combined open flow of 122 million cubic feet per day. In 1937, 40 wells were drilled with a total capacity of 104 million cubic feet. No construction of gas transmission lines or processing plants was reported. A gas well was completed for a flow of 8 million cubic feet per day in the Moulton sand at 2,572 to 2,585 feet, 4 miles north of the Cut Bank gas area.

Gas withdrawals were 20,463 million cubic feet in 1938, about 14 percent less than in 1937. Mild winter weather and curtailed operations at copper smelters and other industrial plants contributed to the reduction in demand for gas.

Production of gas from the several fields in 1938 is shown in the accompanying table, with data on the principal uses to which it was put. About 60 percent of the total decline in output occurred at Cut Bank, and less drastic reductions were made at the Cedar Creek and Kevin-Sunburst fields. Of the less important producing areas, three (Box Elder, Dry Creek, and Whitlash) showed small increases in output and three (Bowdoin, Bowes, and Hardin) small declines.

Al gas produced, except that from the Cedar Creek field, was consumed within the State. Importations from the Rogers Imperial well in Canada continued to augment the supply for Great Falls. The quantity thus imported was about 375 million cubic feet in 1938.

Wastage of gas from gas fields is very small, being estimated at 75 million cubic feet due to losses in drilling in, testing, and faulty connections. About 10 million cubic feet of gas produced with oil escaped to the atmosphere.

*New Mexico.*—Sales of natural gas from the fields of southeastern New Mexico increased moderately in 1938, and the quantity processed

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at gasoline extraction plants gained 62 percent over 1937. Data have been furnished by E. A. Hanson, supervisor, Geological Survey, United States Department of the Interior, Roswell, N. Mex.

*Source and distribution of natural gas in Montana in 1938* [1]

| Field | Total production (M cubic feet) | Utilization | | | Location of principal markets |
|---|---|---|---|---|---|
| | | Domestic (M cubic feet) | Industrial | | |
| | | | M cubic feet | Consumer | |
| Bowdoin | 656,661 | 492,496 | 164,165 | Steam boilers | Glasgow, Malta, Fort Peck, etc. |
| Bowes | 526,248 | 263,124 | 263,124 | Sugar refinery | Havre and Chinook. |
| Box Elder | 276,706 | 207,530 | 69,176 | do | Do. |
| Cedar Creek | 7,181,855 | (2) | (2) | | (2). |
| Cut Bank | 7,704,489 | 3,852,244 | 3,852,245 | Smelters and steam boilers | Anaconda, Butte, Helena, etc. |
| Dry Creek | 881,816 | (2) | (2) | | (2). |
| Hardin | 72,329 | 72,329 | | | Hardin. |
| Kevin-Sunburst | 2,398,471 | 1,198,983 | 1,199,488 | Smelters and steam boilers | Great Falls, Shelby, etc. |
| Whitlash | 764,041 | 464,041 | 300,000 | do | Great Falls, etc. |
| Total | 20,462,616 | [3] 6,550,747 | [3] 5,848,198 | | |

[1] Data supplied by H. J. Duncan, supervisor, Geological Survey, U. S. Department of the Interior.
[2] To Bozeman, Livingston, Big Timber, and intervening towns, mainly domestic.
[3] Excludes Cedar Creek and Dry Creek.

Domestic and commercial markets absorbed 24,399 million cubic feet, of which 23,700 million were produced in Lea County and the balance in Eddy County. A total of 91,800 million cubic feet was run through gasoline plants in 1938 compared with 56,500 million in 1937. Approximately 2,500 million cubic feet were used in gas-lift operations in oil wells and an additional 2,500 million for general fuel and power purposes in the fields.

Nineteen gas wells were completed in 1938 with total initial capacity of 263 million cubic feet per day; both the number and capacity declined from 1937. However, the average daily capacity per gas well increased in 1938 to 13.8 million cubic feet from 10.5 million in 1937. Most gas completions were in or near proven areas and were incidental to the search for oil. The discovery well in the new Lovington oil field of Lea County was completed as a gas well gaging approximately 4.5 million cubic feet from the Yates anhydrite zone.

Although still relatively small, interest and drilling activity have increased in the areas favorable to carbon dioxide development in the Bueyeros field, Harding County, the Wilcox field, Torrance County, and the Wagon Mound area, Mora County.

Production in northwestern New Mexico in 1938 rose 12 percent over 1937 to 2,272 million cubic feet, as reported by J. A. Frost, district engineer, Geological Survey, Farmington, N. Mex. Withdrawals from the Kutz Canyon field increased 29 percent to 1,516 million cubic feet in 1938. Output of the other two producing fields, Blanco and Ute Dome, declined moderately to 29 million and 728 million cubic feet, respectively. No wells were drilled in the district in 1938. Gas waste was small, being limited to that incidental to blowing wells during normal operations.

About 40 percent of the marketed production was used for domestic purposes and 60 percent for industrial.

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*New York.*—As reported by C. A. Hartnagel, assistant State geologist, drilling for natural gas in 1938 was notably active in the southwestern part of the State, in Steuben and Allegany Counties, where the results of deep exploration in the preceding year or two had uncovered productive pools in the Oriskany sandstone. The gas comes from a depth of 4,000 feet or more and is found along anticlinal structures that extend northeast-southwest and probably are a part of the Appalachian folding. Within the two counties 42 wells were drilled, of which 31 were listed as producers. At the close of the year 15 wells were drilling.

Among the outstanding developments was the discovery in March 1938 of the Beach Hill pool, town of Willing, Allegany County, about 4 miles northeast of the State Line field. The new pool is situated on the Watkins (Smethport) anticline. Eleven wells were completed, of which seven were producers with total initial capacity of 79 million cubic feet per day. The Oriskany sand in this field is reached at depths of 4,740 to 5,000 feet. In the area between the Beach Hill and Greenwood pools two wells were drilled that found gas, but they were soon drowned out by salt water and abandoned.

The Woodhull field of Steuben County, discovered in 1937, continued to give good wells. Eighteen producers were drilled during 1938 with average initial capacity of 6.3 million cubic feet per well, compared with 16.6 million cubic feet per well for 20 wells completed in 1937. Six wells were drilling as the year ended.

In Troupsburg Township three wells were completed, all of which were productive. In Greenwood the only new well had to be abandoned because of salt-water intrusion. The town of West Union had two completions, one dry and the other moderately productive. East of Steuben County in Chemung County, further tests of Oriskany sandstone were conducted during 1938 but were unsuccessful. Exploration was in progress in Cayuga and Oneida Counties of central New York. The shallow Camden field, which produces from the Trenton limestone in northern Oneida County, was developed further with favorable results.

From 1934 to 1937 natural-gas production in New York more than tripled owing to development of the Oriskany sand, currently the principal source of gas in the State.

*Ohio.*—Both gas production and drilling in Ohio declined in 1938, according to a report by Dewitt T. Ring, geologist, Ohio Fuel Gas Co. Gas-well completions decreased 14 percent from 1937 and totaled 433—423 in central and southeast Ohio and the remaining 10 in the Lima field. The average initial capacity was 459,000 cubic feet per well; this slight increase over the 1937 average of 442,000 was due chiefly to development of larger wells in the Clinton sand.

Most of the new production came from extensions to existing productive areas rather than from important discoveries. The most active counties were Washington with 44 gas-well completions, Athens 41, Guernsey 35, Licking 32, Knox 28, Meigs 24, Stark 24, and Noble 22.

The Clinton sand yielded a total initial volume of 138 million cubic feet per day from 134 new gas wells, an average of over 1 million cubic feet per well. Continued development of Clinton sand areas in Tuscarawas County resulted in completion of 15 wells in 1938—3 in Franklin Township, 2 in Sandy, 8 in Lawrence, and 1 each in

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Dover and Jefferson Townships. These wells ranged in depth from about 4,500 to 4,950 feet and had initial reservoir pressures of approximately 1,200 to 1,400 pounds. Their open-flow capacities ranged from 28,000 to 8,283,000 cubic feet and averaged only 320,000 cubic feet per well.

Five gas wells drilled in the Newburg sand, a dolomitic phase of the lower Niagara formation, had average open-flow capacities of about 1 million cubic feet per well. Two of these, in Mayfield Township, Cuyahoga County, produced 300,000 cubic feet each naturally with rock pressures of 1,120 pounds. Their open flows were increased to 2.2 million and 1.3 million cubic feet by treatment with acid.

The other outstanding sources of gas production continued to be the Berea sand and the shallower sands above it; 150 Berea wells were completed in 1938, with total initial capacity of 21 million cubic feet per day, and 106 shallow-sand wells, with a total capacity of 29 million cubic feet. Wells drilled to other producing horizons had a total open-flow capacity of about 5 million cubic feet and were as follows: Devonian shale 16, lime 13, Austinburg sand 2, Trenton lime 7.

Further prospecting of the Oriskany sand was unsuccessful in 1938. In Ohio the Oriskany is found only in the eastern part of the State, and its distribution is erratic, the formation being absent in large areas. A well in sec. 16, Sutton Township, Meigs County, penetrated less than 8 inches of Oriskany with a slight show of gas at 3,814 feet. An Oriskany test well in Washington Township, Tuscarawas County, had a show of gas and was abandoned at 3,733 feet. At the close of the year an Oriskany test well was drilling on the Miller farm, sec. 23, German Township, Harrison County, and another in West Virginia on the Burning Springs anticline a short distance south of the Ohio River, in Grant district, Pleasants County.

No new gas- or air-repressuring projects were started in 1938. Five are now in operation, and another was scheduled to start in the eastern part of the State early in 1939.

*Oklahoma.*—Gross production of natural gas in Oklahoma in 1938 was approximately 25 percent less than in 1937, according to records of the Oklahoma Tax Commission. The principal causes of the decline were shrinkage in industrial demand and curtailment in the use of high-pressure gas in oil-production operations in the northern part of the Oklahoma City field. The latter activities consumed large volumes of gas in 1937, most of which was dissipated to the air after forcing the oil to the surface at rapid rates. Casinghead gas production was 252 billion cubic feet in 1938, and production from gas wells was 75 billion cubic feet.

The number of gas wells completed in 1938 was about 160 compared with 123 in 1937. They were scattered over 27 counties, the most active being Caddo, Muskogee, Pontotoc, Creek, Okmulgee, Texas, Stevens, and Osage.

An important gas reserve was proved in Texas County where eight gas wells were completed at rather widely separated points. They ranged in capacity from 3 to 37.5 million cubic feet per day each. The development is an extension of the great Hugoton area of southwestern Kansas, which produces from Permian limestone at depths of 2,700 to 2,900 feet.

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Active drilling in the old Cement field, Caddo County, resulted in completion of several very large gas wells. Capacities of some individual wells were reported as exceeding 100 million cubic feet per day.

The Wolfe gas field (sec. 8 T. 1 N., R. 2 E.), Murray County, was discovered in June 1938, when a well produced 34 million cubic feet of gas from the Bromide at 2,235 to 2,265 feet. Production units of 40 acres were prescribed for the area by the Corporation Commission, which also limited production rates to 25 percent of "potential" open-flow capacities. A show of oil appeared later with the gas. Other gas discoveries were reported in Muskogee, Okmulgee, Payne, Seminole, Kay, Osage, Pittsburg, and Beckham Counties.

Repressuring and maintenance of reservoir pressures in oil sands by injection of natural gas continued to spread in Oklahoma in 1938. About 125 injection wells were drilled in the northeast quarter of the State. Gas is being returned to the oil sands under large unitized blocks of leases in the South Burbank pool and the Avant district, Osage County; the Billings pool, Noble County; and the new Ramsey pool, Payne County.

In December 1938 the Osage Indian Agency notified all operators in the Burbank field that surplus casinghead gas must be returned to the oil sand.

*Pennsylvania.*—Production of natural gas and drilling activity in Pennsylvania declined in 1938, according to information supplied by J. G. Montgomery, Jr., superintendent and chief geologist, United Natural Gas Co., Oil City, Pa.

Completions of new shallow-sand wells during 1938 in the northwest counties declined 30 percent, all areas showing decreases except the new Sliverville sand field southwest of the Bradford oil field. Most wells in this field produced oil as well as gas. No new shallow-sand fields of importance were found.

Two Oriskany-sand discoveries were made, both in Potter County. The first, in Bingham Township, had subnormal rock pressure, indicating that it may be an eastern extension of the older Ellisburg field. The second was in Sharon Township. Developments in 1938 in the four counties in Pennsylvania that produce gas commercially from the Oriskany sand or the Onondaga lime immediately above it resulted in completion of 12 Oriskany gas wells as follows: In Beaver County two producing wells with open-flow capacity of about 3 million cubic feet each and one dry hole were drilled, making a total of five wells producing from the Oriskany sand in this pool at the end of the year. In Fayette County two producers and one dry hole were drilled, making three producing wells in this area. Capacities of gas wells in this area ranged from 2 to 3.5 million cubic feet each with a rock pressure of about 3,000 pounds and depths from 6,825 to 8,159 feet. In Potter County six producers with total capacity of 44.6 million cubic feet per day and nine dry holes were completed. Open-flow tests ranged from 1.9 to 17 million cubic feet per day and rock pressures from 555 to 1,920 pounds. In Tioga County, two producing wells and two dry holes were drilled. Open-flow capacities were 2 and 2.7 million cubic feet and rock pressures 2,090 and 590 pounds.

Twenty-one wildcat wells were drilled in 1938, of which four produced. Two were in Bingham Township and one in Sharon Township, Potter County, and one was in Brookfield Township, Tioga County. At the close of the year nine wildcat wells were drilling.

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No test wells were completed to the Medina sandstone in 1938, but one was drilling to that horizon in Mercer County.

Four wells were drilled with rotary equipment to depths of 6,454 to 8,482 feet. The Lower Devonian formations have proved highly resistant to rotary bits.

Oriskany-sand production from Potter and Tioga Counties totaled about 25 billion cubic feet in 1938, a drop of 50 percent from 1937. This steep decline was caused by rapid depletion of reserves and failure to develop important new fields early in the year.

Production of gas from the shallow fields increased in 1938, partly offsetting the shrinkage in output from the deeper sands.

*South Dakota.*—E. P. Rothrock, State geologist, reports that no important change has taken place in the gas situation in South Dakota during 1938. The volume of production at Pierre and Fort Pierre declined slightly. Production for the year was about 9 million cubic feet. An attempt was made to have gas lines extended to cities in the James Valley as far as Aberdeen, but as yet no action has been taken.

*Texas.*—Data published by the Texas Railroad Commission indicate that natural-gas production in Texas reached a total of about 1,100 billion cubic feet in 1938, an increase of 11 percent over 1937. This figure includes about 45 billion cubic feet used for repressuring and recycling, 50.5 billion extraction loss at gasoline plants, and 137 billion blown to the air—increases over 1937 of 97, 6, and 50 percent, respectively. About 867.5 billion cubic feet of gas were used for other purposes in 1938 and 832.3 billion in 1937. Demand for gas in carbon-black manufacture declined 3 percent in 1938, pipe lines took 2 percent more, and reported use for plant fuel and lease operation increased 30 percent over 1937.

The rapid growth of repressuring and recycling is due largely to improved production methods in the high-pressure distillate fields. Inquiry into the behavior of the lighter hydrocarbons under varying conditions has revealed the great losses in recovery that may result from failure to maintain pressures above critical points in some types of reservoirs. The growing use of pressure-maintenance equipment should conserve large quantities of gas and increase yields of the liquid fractions.

The large increase in waste of residue gas in 1938 over 1937 is due chiefly to oil-production activity in flush areas where high gas-oil ratios are common. The volume blown to the air in the Panhandle was curtailed in the latter months of 1937 to an average of about 25 million cubic feet per day but averaged about 40 percent more in the last quarter of 1938. The greatest losses occurred in the South Texas district in connection with oil production. Gas reported as blown to the air amounted to about 6 million cubic feet per day early in 1937 in this area and to more than 140 million per day during the latter half of 1938. Losses in the Gulf Coast fields in 1938 were about double those of 1937. West Texas gas waste has averaged slightly less than 100 million cubic feet per day for the past 2 years. These data cover residue gas only. The volume of direct waste from producing leases is unknown. The situation has improved to the extent that more gasoline-extraction equipment is used in flush-oil fields to recover a part of the fuel value of the gas before blowing it to the atmosphere.

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Completion of 341 gas wells was reported in Texas in 1938 compared with 425 in 1937. The Panhandle and Southwest Texas districts were the most active with 105 new wells each. North Central Texas and the Gulf Coast districts, with 43 and 36 new gas wells, respectively, were next in activity, followed by the East Central Texas with 25, West Texas with 16, East Texas border with 10, and East Texas with 1.

Two new gas areas were opened in the Panhandle—one in Gray County by the Fowler No. 1, which produced 25 million cubic feet of gas from the granite wash at 2,500 feet, and one in Sherman County by the Davis No. 1, which produced 30 million cubic feet from the same formation at 2,705 to 2,800 feet. In the Southwest Texas district the following distillate discoveries were reported: M. Valdez No. 1 at Banderia, Jim Wells County, 6,419 feet deep; Rooke No. 2 at La Rosa, Refugio County, which produced through perforations at 5,395 to 5,400 feet; and the American Rio Grande No. 1 at Weslaco, which produced from the Frio-Vicksburg sand at 8,634 to 8,642 feet, and the Lynn No. 1 at McAllen, which produced from 5,970 to 5,994 feet, both in Hidalgo County. Gas or distillate discoveries were reported in 10 other counties of the district.

In the West Texas district Tunstill No. 1 in Reeves County was completed in October 1938 with an initial capacity of 2.5 million cubic feet of gas from 3,274 to 3,310 feet. An 8-million cubic-foot well, Voth No. 1, was completed in July in Cooke County, North Central Texas district, from the Ellenburger limestone at 1,802 feet. A discovery in the Strawn formation, the Johnson No. 1, was completed in Eastland County, West Central Texas district, with an initial capacity of 2 million cubic feet per day from 1,482 to 1,488 feet.

Gas proration regulations were applied to Rodessa, also to the "sweet" and "sour" gas areas of the Panhandle field early in 1938. The proration law was attacked and upheld by a three-judge district court.

*Utah.*—Gas production in Utah jumped about 89 percent in 1938 over 1937 owing to increased withdrawals from the Clay Basin field, according to a report by H. J. Duncan, supervisor, Geological Survey, United States Department of the Interior. Clay Basin production, which is piped to Salt Lake City, was 3,709 million cubic feet in 1938 and 1,936 million cubic feet in 1937. The increased volume replaced part of the gas that heretofore had been produced into the same pipeline system from the Baxter Basin and Hiawatha fields, in Wyoming and Colorado, respectively. Production from the Ashley Valley field declined about 10 percent in 1938 to 44 million cubic feet; the entire output was used for domestic purposes in the vicinity.

The only gas well drilled in Utah in 1938 extended the productive limits of the Clay Basin field of Daggett County about 1 mile eastward. It was completed for 16 million cubic feet of initial capacity from the Dakota sand at 6,036 feet with a rock pressure of 2,100 pounds. There are now five gas wells in the Dakota and one in the Frontier on the Clay Basin structure.

Forty-two miles of a 52.7-mile 18-inch loop line were completed from Bigelow Hills, Wyo., to Coalville, Utah, partly paralleling the present line from Green River, Wyo., to Salt Lake City.

Very little gas was wasted or used in the field.

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*Washington.*—Completion of four small gas wells in the Shallow field, 8 miles north of Bellingham, Whatcom County, marked the only gas development in Washington in 1938, according to information supplied by S. L. Glover, assistant supervisor of geology, Washington Department of Conservation. Depths of the wells ranged from 560 to 1,785 feet. The gas occurs in the Chuckanut formation with salt water, which requires the use of a separator at each well. Capacity of individual wells is only a few thousand cubic feet per day, but further development, it is hoped, will produce gas in commercially profitable amounts. The present production is distributed locally for domestic use.

Production from the Rattlesnake Hills field, Benton County, declined about 15 percent in 1938 to 121 million cubic feet valued at $75,488. Of the total, 8 million cubic feet were used in field operations and 111 million were sold to consumers in seven towns in the Yakima Valley.

Some prospecting for oil and gas was reported in 11 scattered counties.

The manufacture of dry ice from carbon dioxide near Klickitat, Klickitat County, continued to increase as in recent years, the 1938 production being 1,644,000 pounds valued at $50,740, from 13 million cubic feet of gas. All the natural springs have been abandoned in favor of shallow drilled wells which afford better control of production and larger volumes. One well recently completed at a depth of 70 feet produces enough gas for 3,600 pounds of dry ice per day.

*West Virginia.*—Drilling and pipe-line construction were considerably less in 1938 than the high level of 1937, as reported by David B. Reger, consulting geologist, Morgantown, W. Va., and R. C. Tucker, assistant State geologist. Gas-well completions totaled 504, a decline of 26 percent, but the number of successful wells in the Oriskany sand increased to 120 from 100 in 1937.

That interest in development work in West Virginia was maintained in 1938 is indicated by permits to abandon, which declined from 641 in 1937 to 570 in 1938; permits to drill, which increased from 1,034 to 1,085; and permits to deepen, which increased from 71 to 131. It is estimated that gas production in West Virginia was about 150 billion cubic feet, or approximately that of 1937.

Exploitation of the Oriskany sand continued vigorously in 1938. Important extensions were made to known producing fields, but little success attended efforts to discover new areas. In Kanawha County 120 Oriskany-sand completions were reported, of which 116 were gas wells with total open-flow capacity of 1,040 million cubic feet per day. The proved area of the three recognized pools in the county was increased to approximately 63,000 acres. The largest pool in the Elk and Poca districts, Kanawha County, was extended in 1938 into the Ripley and Washington districts of Jackson County by drilling of three gas wells in the latter districts. A wildcat well in Ravenswood district, Jackson County, gaged 337,000 cubic feet from the Oriskany with 1,600 pounds rock pressure, but completion was delayed because of lost tools. Failures in the Oriskany were drilled in the Teays Valley district, Putnam County; in the Tucker district, Wirt County; and in the Steel and Lubeck districts, Wood County. The Lubeck well showed gas in the Oriskany. Three dry wells in the Oriskany sand were drilled in Boone County, two in Jackson County, and one in Clay County.

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Eight wildcat rigs were active at the close of the year in six counties.

The leading counties in gas development and the number of successful gas wells in each were: Boone 15, Braxton 10, Cabell 49, Calhoun 28, Doddridge 10, Gilmer 65, Kanawha 129, Lincoln 18, Ritchie 37, Wayne 20, and Wetzel 30. Wells completed in other sands than the Oriskany totaled 384, more than three times the number of Oriskany wells, but their initial capacity was less than a fifth that of the Oriskany wells.

A new area was opened in Barbour County by completion of a small Benson sand well north of Volga. A Clay County wildcat southeast of Villa Nova produced 510,000 cubic feet from the Webster Springs sand (upper Mississippian) at a depth of 1,708 to 1,758 feet. This sand has not heretofore been known as productive. In Wetzel County a 10-million cubic-foot well was completed in the Gordon sand north of Newdale in an area where gas has come chiefly from the shallower Maxton sand.

Considerable gas from new operations is now being moved to favorably situated old wells in Harrison, Lewis, and Taylor Counties for underground storage. A large quantity of Oriskany gas has been piped to central Ohio for storage in old Clinton-sand wells.

The price of gas in the field apparently continued the decline that has proceeded without interruption since 1931. The available supply greatly exceeds the immediate demands of present markets.

*Wyoming.*—Gross production of gas in Wyoming in 1938, including estimates of unmetered gas and that used for recycling and repressuring, was more than 38 billion cubic feet, about the same as in 1937, according to a report by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo. Of the total, 1.4 percent was lost or wasted in field operations and 2.1 percent was lost in testing or controlling new wells at Beaver Creek, Big Piney, Dry Piney, and Muskrat.

Production of casinghead gas in the Salt Creek field was 10,010 million cubic feet in 1938, of which 6,833 million were returned to the reservoir after extraction of its gasoline content, leaving a net withdrawal from the field of 3,177 million cubic feet. Natural-gasoline production was about 26 million gallons, with an indicated extraction loss or shrinkage of 671 million cubic feet. Of the residue gas utilized above ground, 1,744 million cubic feet were consumed in field operations, 680 million used to generate electric power, and 81 million lost in distribution.

Gas production declined moderately in nearly all fields. Notable exceptions were Big Medicine Bow and Muskrat, whose output more than doubled. Withdrawals from Little Buffalo Basin and Little and Big Polecat were slightly larger. The largest producing fields and their 1938 production in millions of cubic feet were as follows: Big Sand Draw 4,174, Lance Creek 3,620, South Baxter Basin 3,460, Big Medicine Bow 3,206, Muskrat 2,210, North Baxter Basin 1,960, Elk Basin 1,614, and Little Buffalo Basin 1,523.

Fourteen gas wells were completed in 1938 in Wyoming (12 in 1937), of which 11 with an initial production of 133 million cubic feet per day were in old fields and 3 with an initial production of 43 million cubic feet were in new fields.

At Beaver Creek, Fremont County, a *unitized structure*, a well in sec. 3, T. 33 N., R. 96 W., was completed on April 29, 1938, with 7.8 million cubic feet of capacity and a rock pressure of 3,475 pounds from

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the Morrison formation at 8,230 to 8,285 feet. The situation is near a pipe line, but there is no immediate market for the gas.

A discovery well was completed on June 21, 1938, on the Oil Springs structure, Carbon County (sec. 3, T. 23 N., R. 79 W.), which produced 19.3 million cubic feet initially with a rock pressure of 1,100 pounds from the Sundance formation at 2,222 to 2,315 feet. A second well, completed in sec. 2 on December 6, had an initial open-flow capacity of 16 million cubic feet from the same horizon.

At Big Piney and Dry Piney, both in Sublette County, southwestern Wyoming, gas blow-outs that occurred during the drilling of wildcat wells indicate the possibility of gas accumulations. However, the area is sparsely populated and remote from markets. Drilling operations will continue in 1939 at both wells.

New gas reserves were discovered in the Muskrat field, Fremont County, by a well in sec. 4, T. 33 N., R. 92 W., which made 40 million cubic feet of gas from the Lakota sand at 5,306 to 5,320 feet. At Elk Basin the deepening of an old well resulted in a 73-million cubic-foot flow of gas which increased the available supply for the pipe line to Billings, Mont. Four wells drilled at Baxter Basin had a combined open-flow capacity of 15 million cubic feet per day.

The production from Lance Creek before December 16, 1937, was used mainly in a carbon-black plant, but under a unit plan effective January 1, 1938, it is now used in drilling, repressuring, and field activities. About 1 billion cubic feet of the Lance Creek output in 1938 were used in field operations, about 2.5 billion were utilized in repressuring, and 75 million cubic feet were lost or wasted. No carbon-black plants are now operating in Wyoming.

Gas wells connected to existing pipe lines are adequate for immediate needs. Increased use of natural gas may be provided through increased repressuring activities in some of the larger oil fields.

## CONSUMPTION

Less natural gas was used in 1938 by all classes of consumers except petroleum refineries and electric-power plants. The decline in miscellaneous industrial consumption was sharpest, about 15 percent, and was particularly marked in the manufacturing sections of East-Central United States. Domestic consumers used 16 percent of the gas in 1938 and 15 percent in 1937. Industrial consumption took 79 and 80 percent of the total, respectively.

*Natural gas consumed in the United States, 1933–37*

| Year | Domestic and commercial consumption | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Consumers (thousands) [1] | | | Billions of cubic feet | | | Average number of M cubic feet used per domestic and commercial consumer | Average value at points of consumption per M cubic feet (cents) |
| | Domestic | Commercial | Total | Domestic | Commercial | Total | | |
| 1933 | 6,691 | 541 | 7,232 | 283 | 86 | 369 | 51.0 | 68.4 |
| 1934 | 6,984 | 582 | 7,566 | 288 | 91 | 379 | 50.2 | 68.6 |
| 1935 | 7,391 | 613 | 8,004 | 314 | 100 | 414 | 51.7 | 68.5 |
| 1936 | 8,017 | 657 | 8,674 | 343 | 112 | 455 | 52.5 | 67.1 |
| 1937 | 8,348 | 680 | 9,028 | 372 | 117 | 489 | 54.2 | 67.6 |

[1] Includes consumers served with mixed gas.

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*Natural gas consumed in the United States, 1933–37*—Continued

| Year | Industrial consumption | | | | | | | | Total consumption | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Billions of cubic feet | | | | | | | Average value at points of consumption per M cubic feet (cents) | Billions of cubic feet | Average value at points of consumption per M cubic feet (cents) |
| | Field | Carbon black | Petroleum refineries | Electric public-utility power plants [2] | Portland cement plants [3] | Other industrial | Total industrial | | | |
| 1933 | 491 | 190 | 66 | 103 | 22 | 312 | 1,184 | 9.8 | 1,553 | 23.7 |
| 1934 | 555 | 230 | 80 | 128 | 27 | 366 | 1,386 | 9.7 | 1,765 | 22.3 |
| 1935 | 580 | 242 | 80 | 125 | 27 | 442 | 1,496 | 9.7 | 1,910 | 22.4 |
| 1936 | 619 | 283 | 93 | 156 | 37 | 518 | 1,706 | 10.0 | 2,161 | 22.0 |
| 1937 | 651 | 341 | 113 | 171 | 41 | 597 | 1,914 | 10.3 | 2,403 | 22.0 |

[2] Federal Power Commission.
[3] Chapters on Cement, in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.

*Natural gas consumed in the United States, 1933–37, by States, in millions of cubic feet*

| State | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Alabama | 7,510 | 7,932 | 10,563 | 16,630 | 16,593 |
| Alaska | 19 | | | | |
| Arizona | 2,513 | 4,729 | 5,603 | 8,232 | 12,857 |
| Arkansas | 22,775 | 25,075 | 26,476 | 30,986 | 35,074 |
| California | 259,799 | 268,122 | 284,109 | 320,406 | 329,769 |
| Colorado | 15,862 | 16,449 | 17,233 | 19,713 | 20,816 |
| District of Columbia | 2,046 | 2,640 | 2,707 | 3,104 | 3,458 |
| Florida | 494 | 554 | 692 | 1,005 | 1,389 |
| Georgia | 4,450 | 5,357 | 8,082 | 11,575 | 13,893 |
| Illinois | 33,341 | 45,084 | 57,319 | 72,516 | 78,650 |
| Indiana | 5,996 | 12,864 | 15,613 | 18,564 | 23,551 |
| Iowa | 11,408 | 16,636 | 19,077 | 20,918 | 21,354 |
| Kansas | 57,032 | 65,599 | 72,806 | 82,025 | 96,822 |
| Kentucky | 13,222 | 14,106 | 15,826 | 18,159 | 18,154 |
| Louisiana | 115,800 | 137,413 | 151,934 | 166,485 | 174,153 |
| Maryland | 667 | 752 | 784 | 915 | 1,011 |
| Michigan | 1,528 | 2,789 | 4,203 | 11,142 | 24,112 |
| Minnesota | 3,547 | 7,125 | 10,579 | 11,918 | 13,111 |
| Mississippi | 5,818 | 7,219 | 8,765 | 11,368 | 13,327 |
| Missouri | 27,584 | 29,792 | 33,060 | 40,124 | 46,898 |
| Montana | [1] 12,222 | [1] 12,444 | [1] 16,832 | [1] 19,894 | [1] 21,594 |
| Nebraska | 10,293 | 12,789 | 14,310 | 16,780 | 17,263 |
| New Mexico | 13,400 | 15,625 | 18,419 | 19,814 | 28,056 |
| New York | 19,912 | 31,209 | 35,705 | 40,638 | 50,080 |
| North Dakota | 1,020 | 1,112 | 1,382 | 1,578 | 1,641 |
| Ohio | 92,762 | 94,998 | 105,896 | 121,381 | 125,133 |
| Oklahoma | 242,494 | 249,721 | 258,598 | 260,120 | 269,604 |
| Pennsylvania | 73,627 | 87,474 | 91,601 | 110,195 | 119,501 |
| South Dakota | 3,264 | 3,901 | 4,656 | 5,061 | 5,519 |
| Tennessee | 7,369 | 8,062 | 9,479 | 11,913 | 13,353 |
| Texas | 412,428 | 501,047 | 525,697 | 598,088 | 706,120 |
| Utah | 5,853 | 6,776 | 8,747 | 10,552 | 12,449 |
| Virginia | 213 | 292 | 343 | 447 | 550 |
| Washington | 111 | 104 | 138 | 141 | 143 |
| West Virginia | 46,933 | 52,353 | 53,763 | 57,978 | 65,395 |
| Wyoming | 20,087 | 16,844 | 18,904 | 20,153 | 21,648 |
| Total United States | 1,553,399 | 1,764,988 | 1,909,901 | 2,160,518 | 2,403,041 |

[1] Includes natural gas piped from Canada.

In 1937 increased consumption of natural gas was general in all parts of the country. The sharpest gains over 1936 were in Arizona, Arkansas, Michigan, New Mexico, and Texas.

Domestic consumers of natural gas numbered 8,348,000 and commercial consumers 680,000 at the end of 1937. These totals were

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4.1 and 3.5 percent larger than at the end of 1936. Further growth doubtless took place in 1938.

*Treated for natural gasoline.*—The volume of natural gas processed at natural-gasoline plants in 1938 was about 2,115 billion cubic feet, estimated on the basis of an average recovery of 1 gallon per thousand cubic feet. In 1937, 2,108.8 billion cubic feet were processed, equal to 88 percent of total consumption. The volume processed in 1938 was 94 percent of the consumption. The gain in percentage reflected the efforts of natural-gasoline manufacturers to increase their supplies.

Pronounced increases in volume handled in 1937 over 1936 in California, New Mexico, and Texas continued through 1938. In Oklahoma and Louisiana, however, the volume was considerably less in 1938 than in 1937.

*Natural gas treated at natural-gasoline plants in the United States, 1933–37, by States*

[Millions of cubic feet]

| State | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Alaska | 20 | | | | |
| Arkansas | 4,949 | 3,250 | 3,371 | 2,955 | 4,031 |
| California | 326,016 | 325,629 | 310,016 | 372,118 | 381,568 |
| Colorado | 547 | 511 | 222 | 223 | 153 |
| Illinois | 1,701 | 1,512 | 1,076 | 971 | 1,027 |
| Kansas | 52,939 | 69,859 | 87,669 | 106,230 | 153,416 |
| Kentucky | 22,244 | 21,704 | 29,772 | 35,493 | 34,981 |
| Louisiana | 80,891 | 70,534 | 81,868 | 115,606 | 144,474 |
| Michigan | 444 | 410 | 1,755 | 1,419 | 1,381 |
| Montana | 4,358 | 4,114 | 6,382 | 8,238 | 9,062 |
| New Mexico | 10,399 | 11,904 | 11,786 | 29,489 | 61,625 |
| New York | 406 | 375 | 27 | 22 | 50 |
| Ohio | 21,901 | 25,100 | 29,622 | 33,103 | 33,625 |
| Oklahoma | 351,989 | 299,183 | 260,757 | 255,433 | 338,007 |
| Pennsylvania | 31,810 | 29,346 | 33,348 | 34,168 | 31,508 |
| Texas | 532,148 | 787,078 | 828,570 | 673,483 | 754,696 |
| West Virginia | 90,072 | 108,097 | 118,789 | 128,488 | 140,512 |
| Wyoming | 18,630 | 17,566 | 16,970 | 17,561 | 18,684 |
| | 1,551,464 | 1,776,172 | 1,822,000 | 1,815,000 | 2,108,800 |
| Percent of total consumption | 100 | [1] 101 | 95 | 84 | 88 |

[1] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is blown to the air and not included in total consumption.

*Domestic and commercial.*—Domestic use of natural gas fell about 3 percent in 1938. Demand is estimated at 362 billion cubic feet compared with 372 billion in 1937. As the number of domestic meters in use was greater in 1938 than in 1937, the average consumption per meter declined more abruptly than did the total consumption. In a few States, notably California, Michigan, and Indiana, volume of domestic sales increased. The estimated average value of gas purchased by domestic consumers in 1938 was 74.0 cents per thousand cubic feet, slightly above the comparable figure for 1937 of 73.6 cents. The total value of domestic sales was about $267,880,000 in 1938 compared with $273,577,000 in 1937.

Commercial consumption declined about 3 percent in 1938 to 114 billion cubic feet. The average value at points of consumption is estimated to have advanced to 49.0 cents per thousand cubic feet from the 1937 average of 48.7 cents, indicating a total value in 1938 of $55,860,000.

The weather in the United States in 1938 was unseasonably warm during the months of heavy gas consumption. This factor undoubtedly reduced somewhat the demand from domestic and commercial customers.

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*Domestic and commercial consumption of natural gas in the United States in 1937, by States* [1]

| State | Domestic | | | | Commercial | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Consumers | M cubic feet | Value at points of consumption | | Consumers | M cubic feet | Value at points of consumption | | Consumers | M cubic feet | Value at points of consumption | |
| | | | Total | Average (cents) | | | Total | Average (cents) | | | Total | Average (cents) |
| Alabama | 26,210 | 1,188,000 | $1,341,000 | 112.9 | 3,280 | 689,000 | $327,000 | 47.5 | 29,490 | 1,877,000 | $1,668,000 | 88.9 |
| Arizona | 25,580 | 679,000 | 1,123,000 | 165.4 | 2,660 | 609,000 | 364,000 | 59.8 | 28,240 | 1,288,000 | 1,487,000 | 115.5 |
| Arkansas | 64,260 | 5,678,000 | 3,110,000 | 54.8 | 10,320 | 3,177,000 | 1,112,000 | 35.0 | 74,580 | 8,855,000 | 4,222,000 | 47.7 |
| California | 1,483,510 | 65,758,000 | 55,447,000 | 84.3 | 89,750 | 15,951,000 | 9,041,000 | 56.7 | 1,573,260 | 81,709,000 | 64,488,000 | 78.9 |
| Colorado | 92,240 | 4,927,000 | 3,927,000 | 79.7 | 8,580 | 1,558,000 | 898,000 | 57.6 | 100,820 | 6,485,000 | 4,825,000 | 74.4 |
| District of Columbia | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) |
| Florida | 3,460 | 108,000 | 152,000 | 140.7 | 310 | 39,000 | 31,000 | 79.5 | 3,770 | 147,000 | 183,000 | 124.5 |
| Georgia | 77,380 | 3,925,000 | 3,491,000 | 88.9 | 5,730 | 1,662,000 | 647,000 | 38.9 | 83,110 | 5,587,000 | 4,138,000 | 74.1 |
| Illinois | 1,169,650 | 18,408,000 | 23,229,000 | 126.2 | 61,360 | 4,455,000 | 3,838,000 | 86.2 | 1,231,010 | 22,863,000 | 27,067,000 | 118.4 |
| Indiana | 115,590 | 1,882,000 | 1,945,000 | 103.3 | 5,710 | 278,000 | 253,000 | 91.0 | 121,300 | 2,160,000 | 2,198,000 | 101.8 |
| Iowa | 109,910 | 3,741,000 | 3,807,000 | 101.8 | 8,150 | 1,377,000 | 815,000 | 59.2 | 118,060 | 5,118,000 | 4,622,000 | 90.3 |
| Kansas | 197,460 | 15,761,000 | 9,492,000 | 60.2 | 23,680 | 8,767,000 | 2,931,000 | 33.4 | 221,140 | 24,528,000 | 12,423,000 | 50.6 |
| Kentucky | 156,690 | 7,981,000 | 4,451,000 | 55.8 | 18,870 | 2,385,000 | 1,179,000 | 49.4 | 175,560 | 10,366,000 | 5,630,000 | 54.3 |
| Louisiana | 157,400 | 8,291,000 | 5,806,000 | 70.0 | 19,300 | 4,270,000 | 1,804,000 | 42.2 | 176,700 | 12,561,000 | 7,610,000 | 60.6 |
| Maryland | 3 191,020 | 3 3,975,000 | 3 3,157,000 | 3 79.4 | 3 8,990 | 3 487,000 | 3 350,000 | 3 71.9 | 3 200,010 | 3 4,462,000 | 3 3,507,000 | 3 78.6 |
| Michigan | 515,950 | 14,181,000 | 16,715,000 | 117.9 | 20,530 | 1,853,000 | 2,070,000 | 111.7 | 536,480 | 16,034,000 | 18,785,000 | 117.2 |
| Minnesota | 135,650 | 3,675,000 | 4,084,000 | 111.1 | 7,420 | 1,309,000 | 782,000 | 59.7 | 143,070 | 4,984,000 | 4,866,000 | 97.6 |
| Mississippi | 35,460 | 2,692,000 | 1,799,000 | 66.8 | 6,440 | 1,922,000 | 618,000 | 32.2 | 41,900 | 4,614,000 | 2,417,000 | 52.4 |
| Missouri | 362,220 | 11,011,000 | 9,529,000 | 86.5 | 33,940 | 4,002,000 | 2,498,000 | 62.4 | 396,160 | 15,013,000 | 12,027,000 | 80.1 |
| Montana | 34,000 | 5,634,000 | 2,621,000 | 46.5 | 4,490 | 3,804,000 | 1,114,000 | 29.3 | 38,490 | 9,438,000 | 3,735,000 | 39.6 |
| Nebraska | 111,120 | 4,769,000 | 3,634,000 | 76.2 | 7,390 | 1,423,000 | 786,000 | 55.2 | 118,510 | 6,192,000 | 4,420,000 | 71.4 |
| New Mexico | 17,550 | 1,334,000 | 969,000 | 72.6 | 2,350 | 1,009,000 | 393,000 | 38.9 | 19,900 | 2,343,000 | 1,362,000 | 58.1 |
| New York | 395,130 | 14,678,000 | 12,142,000 | 82.7 | 33,020 | 2,621,000 | 1,991,000 | 76.0 | 428,150 | 17,299,000 | 14,133,000 | 81.7 |
| North Dakota | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) |
| Ohio | 1,156,680 | 56,738,000 | 33,673,000 | 59.3 | 111,450 | 11,512,000 | 6,442,000 | 56.0 | 1,268,130 | 68,250,000 | 40,115,000 | 58.8 |
| Oklahoma | 225,270 | 20,274,000 | 9,281,000 | 45.8 | 29,920 | 8,527,000 | 2,799,000 | 32.8 | 255,190 | 28,801,000 | 12,080,000 | 41.9 |
| Pennsylvania | 651,310 | 35,609,000 | 21,880,000 | 61.4 | 55,900 | 8,198,000 | 4,545,000 | 55.4 | 707,210 | 43,807,000 | 26,425,000 | 60.3 |
| South Dakota | 14,370 | 1,157,000 | 882,000 | 76.2 | 1,720 | 1,149,000 | 460,000 | 40.0 | 16,090 | 2,306,000 | 1,342,000 | 58.2 |
| Tennessee | 39,920 | 2,294,000 | 1,971,000 | 85.9 | 5,290 | 1,865,000 | 755,000 | 40.5 | 45,210 | 4,159,000 | 2,726,000 | 65.5 |
| Texas | 560,800 | 31,205,000 | 24,196,000 | 77.5 | 70,480 | 15,102,000 | 5,911,000 | 39.1 | 631,280 | 46,307,000 | 30,107,000 | 65.0 |
| Utah | 3 28,400 | 3 2,716,000 | 3 1,724,000 | 3 63.5 | 3 1,510 | 3 1,223,000 | 3 424,000 | 3 34.7 | 3 29,910 | 3 3,939,000 | 3 2,148,000 | 3 54.5 |
| Virginia | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) |
| Washington | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) | (3) |
| West Virginia | 173,590 | 18,129,000 | 6,579,000 | 36.3 | 18,940 | 4,907,000 | 1,638,000 | 33.4 | 192,530 | 23,036,000 | 8,217,000 | 35.7 |
| Wyoming | 20,610 | 3,446,000 | 1,420,000 | 41.2 | 2,310 | 1,260,000 | 345,000 | 27.4 | 22,920 | 4,706,000 | 1,765,000 | 37.5 |
| Total: 1937 | 8,348,390 | 371,844,000 | 273,577,000 | 73.6 | 679,790 | 117,390,000 | 57,161,000 | 48.7 | 9,028,180 | 489,234,000 | 330,738,000 | 67.6 |
| 1936 | 8,017,390 | 343,346,000 | 251,617,000 | 73.3 | 656,720 | 111,623,000 | 53,693,000 | 48.1 | 8,674,110 | 454,969,000 | 305,310,000 | 67.1 |

[1] Includes natural gas used with manufactured gas.

[2] Maryland includes District of Columbia and Virginia.

[3] Utah includes North Dakota and Washington.

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*Field.*—Field operations are estimated to have consumed 620 billion cubic feet of natural gas in 1938, 5 percent less than the 1937 total of 651 billion. Field use decreased in most States, but the most pronounced drop probably was in Oklahoma and Kansas. Active oil development in Illinois and Arkansas doubtless caused marked increases in field consumption in those States. In 1937 the three most important oil-producing States, Texas, California, and Oklahoma, with 76 percent of the United States output, used 541 billion cubic feet of gas for field purposes.

*Carbon black.*—The volume of natural gas burned in carbon-black manufacture in 1938 was 325 billion cubic feet, almost 5 percent less than in the record year 1937. Consumption in Texas declined only 0.5 percent and that in Louisiana 39 percent. The use of gas in carbon-black plants in the Monroe field of Louisiana has been decreasing for several years. The gas used in Oklahoma, Kansas, and Wyoming, the only other States producing carbon black, totaled slightly more in 1938 than in 1937 but represented only 3 percent of the national total.

*Petroleum refineries.*—The volume of natural gas consumed at petroleum refineries in 1938 is estimated to have increased about 8 percent over 1937 to 122 billion cubic feet. Although crude runs to stills at refineries in the United States as a whole were slightly less in 1938 than in 1937, they increased considerably in some of the districts where natural gas is used most widely as a refinery fuel. The refineries of Texas and California are by far the most important users of natural gas for this purpose. The use of natural gas at refineries has grown rapidly since 1933 when only 66 billion cubic feet were consumed.

*Electric public-utility power plants.*—A total of about 171 billion cubic feet of natural gas was used in 1938 to generate electric power at public-utility power plants, about the same quantity as in 1937. Therefore, the relative importance of natural gas as a source of energy in electric-power production increased somewhat in 1938, as the total consumption of all fuels was 9 percent less than in 1937. On the basis of the B. t. u. content of fuels consumed, natural gas supplied 13.8 percent of the total heat energy utilized in 1938 and 12.6 percent in 1937. Factors used in calculating the B. t. u. values of fuels were 26 million B. t. u. per short ton of coal, 6 million B. t. u. per barrel of fuel oil, and 1,050 B. t. u. per cubic foot of natural gas.

*Portland-cement plants.*—Natural gas consumed at portland-cement plants in 1938 totaled about 37 billion cubic feet, a decline of 8 percent from 1937. The reduction in demand was due to curtailment of cement production, which fell about 10 percent in 1938 in common with most industrial activities. Cement plants in the Mid-Continent area and Texas are the principal users of natural gas, probably owing to the low price for industrial gas in those sections.

*Other industrial.*—Depressed business conditions, which were felt particularly during the first three quarters of 1938, reduced substantially the demand for natural gas for miscellaneous industrial uses. It is estimated that "other industrial" demand in 1938 declined about 15 percent from 1937 to 510 billion cubic feet. Curtailment was particularly severe in Ohio, Pennsylvania, and West Virginia, where the steel and ceramic industries are large consumers.

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*Industrial consumption of natural gas in the United States in 1937, by States and uses*

| State | Field (drilling, pumping, and operating gasoline-recovery plants) | | Manufacture of carbon black | | | Fuel at petroleum refineries, electric public-utility power plants, portland-cement plants, and other industrial | | | | | | Total industrial | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Value at points of consumption | | M cubic feet | | | | Value at points of consumption | | | Value at points of consumption | |
| | M cubic feet (estimated) | Value at points of consumption (estimated) | M cubic feet | Total | Average (cents) | Petroleum refineries | Electric public-utility power plant | Other industrial | Total | Total | Average (cents) | M cubic feet | Total | Average (cents) |
| Alabama | | | | | | | | 14,716,000 | 14,716,000 | $2,495,000 | 17.0 | 14,716,000 | $2,495,000 | 17.0 |
| Arizona | | | | | | | 1,824,000 | 9,745,000 | 11,569,000 | 2,329,000 | 20.1 | 11,569,000 | 2,329,000 | 20.1 |
| Arkansas | 6,577,000 | $501,000 | | | | 3,391,000 | 2,695,000 | 13,550,000 | 19,642,000 | 2,459,000 | 12.5 | 26,219,000 | 2,960,000 | 11.3 |
| California | 140,743,000 | 9,229,000 | | | | 32,619,000 | 15,554,000 | 59,144,000 | 107,317,000 | 17,372,000 | 16.2 | 248,060,000 | 26,601,000 | 10.7 |
| Colorado | 372,000 | 17,000 | | | | 2,000 | 425,000 | 13,532,000 | 13,959,000 | 2,190,000 | 15.7 | 14,331,000 | 2,207,000 | 15.4 |
| District of Columbia | | | | | | | | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Florida | | | | | | | | 1,242,000 | 1,242,000 | 183,000 | 14.7 | 1,242,000 | 183,000 | 14.7 |
| Georgia | | | | | | | 3,596,000 | 4,710,000 | 8,306,000 | 1,408,000 | 17.0 | 8,306,000 | 1,408,000 | 17.0 |
| Illinois | 1,275,000 | 101,000 | | | | 101,000 | 3,733,000 | 50,678,000 | 54,512,000 | 10,987,000 | 20.2 | 55,787,000 | 11,088,000 | 19.9 |
| Indiana | 152,000 | 17,000 | | | | 354,000 | 7,864,000 | 13,021,000 | 21,239,000 | 4,606,000 | 21.7 | 21,391,000 | 4,623,000 | 21.6 |
| Iowa | | | | | | | 4,733,000 | 11,503,000 | 16,236,000 | 2,634,000 | 16.2 | 16,236,000 | 2,634,000 | 16.2 |
| Kansas | 21,762,000 | 1,634,000 | (2) | (2) | (2) | 5,588,000 | 16,357,000 | [2]28,587,000 | [2]50,532,000 | [2]6,541,000 | [2]12.9 | 72,294,000 | 8,175,000 | 11.3 |
| Kentucky | 1,220,000 | 158,000 | | | | | | 6,568,000 | 6,568,000 | 1,772,000 | 27.0 | 7,788,000 | 1,930,000 | 24.8 |
| Louisiana | 32,022,000 | 1,987,000 | 39,406,000 | $1,040,000 | 2.6 | 10,460,000 | 25,564,000 | 54,140,000 | 90,164,000 | 10,633,000 | 11.8 | 161,592,000 | 13,660,000 | 8.5 |
| Maryland | | | | | | | | [1]557,000 | [1]557,000 | [1]343,000 | [1]61.6 | [1]557,000 | [1]343,000 | [1]61.6 |
| Michigan | 1,072,000 | 104,000 | | | | 2,000 | | 7,004,000 | 7,006,000 | 3,694,000 | 52.7 | 8,078,000 | 3,798,000 | 47.0 |
| Minnesota | | | | | | | 1,337,000 | 6,790,000 | 8,127,000 | 1,561,000 | 19.2 | 8,127,000 | 1,561,000 | 19.2 |
| Mississippi | | | | | | | 1,410,000 | 7,303,000 | 8,713,000 | 1,132,000 | 13.0 | 8,713,000 | 1,132,000 | 13.0 |
| Missouri | 409,000 | 70,000 | | | | | 8,306,000 | 23,170,000 | 31,476,000 | 5,453,000 | 17.3 | 31,885,000 | 5,523,000 | 17.3 |
| Montana | 1,501,000 | 98,000 | | | | 580,000 | 691,000 | 9,384,000 | 10,655,000 | 1,500,000 | 14.1 | 12,156,000 | 1,598,000 | 13.1 |
| Nebraska | | | | | | | 2,819,000 | 8,252,000 | 11,071,000 | 1,947,000 | 17.6 | 11,071,000 | 1,947,000 | 17.6 |
| New Mexico | 16,414,000 | 378,000 | | | | 104,000 | 3,436,000 | 5,759,000 | 9,299,000 | 1,348,000 | 14.5 | 25,713,000 | 1,726,000 | 6.7 |
| New York | 268,000 | 23,000 | | | | 2,155,000 | 4,114,000 | 26,244,000 | 32,513,000 | 6,143,000 | 18.9 | 32,781,000 | 6,166,000 | 18.8 |
| North Dakota | | | | | | | (2) | (2) | (2) | (2) | (2) | (2) | (2) | (2) |
| Ohio | 2,569,000 | 443,000 | | | | 20,000 | 3,738,000 | 50,556,000 | 54,314,000 | 18,016,000 | 33.2 | 56,883,000 | 18,459,000 | 32.5 |
| Oklahoma | 188,598,000 | 5,492,000 | (2) | (2) | (2) | 10,288,000 | 9,853,000 | [2]32,064,000 | [2]52,205,000 | [2]4,643,000 | [2]8.9 | 240,803,000 | 10,135,000 | 4.2 |
| Pennsylvania | 6,026,000 | 1,360,000 | | | | 1,960,000 | 3,113,000 | 64,595,000 | 69,668,000 | 19,752,000 | 28.4 | 75,694,000 | 21,112,000 | 27.9 |
| South Dakota | | | | | | | 968,000 | 2,245,000 | 3,213,000 | 550,000 | 17.1 | 3,213,000 | 550,000 | 17.1 |
| Tennessee | | | | | | 2,000 | 4,880,000 | 4,312,000 | 9,194,000 | 1,608,000 | 17.5 | 9,194,000 | 1,608,000 | 17.5 |
| Texas | 211,612,000 | 7,261,000 | 291,199,000 | 3,032,000 | 1.0 | 40,247,000 | 42,845,000 | 73,910,000 | 157,002,000 | 19,351,000 | 12.3 | 659,813,000 | 29,644,000 | 4.5 |
| Utah | 51,000 | 2,000 | | | | 4,000 | [2]221,000 | [2]10,018,000 | [2]10,243,000 | [2]1,083,000 | [2]10.6 | [2]10,294,000 | [2]1,085,000 | [2]10.5 |

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| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Virginia | 12,162,000 | 2,083,000 | | | | | 686,000 | 62,000 | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| West Virginia | 6,515,000 | 241,000 | (3) | (1) | (2) | 4,442,000 | 429,000 | [2] 5,556,000 | [2] 10,427,000 | [2] 798,000 | [2] 7.7 | 16,942,000 | 1,039,000 | 6.1 | | |
| Wyoming | | | 10,490,000 | 222,000 | 2.1 | | | | | | | | | | | |
| Miscellaneous | | | | | | | | | | | | | | | | |
| Total: 1937 | 651,320,000 | 31,199,000 | 341,085,000 | 4,294,000 | 1.3 | 113,005,000 | 170,567,000 | 637,830,000 | 921,402,000 | 161,298,000 | 17.5 | 1,913,807,000 | 196,791,000 | 10.3 | | |
| 1936 | 618,468,000 | 28,397,000 | 283,421,000 | 3,681,000 | 1.3 | 93,183,000 | 156,080,000 | 554,397,000 | 803,660,000 | 138,051,000 | 17.2 | 1,705,549,000 | 170,129,000 | 10.0 | | |

[1] Maryland includes District of Columbia and Virginia.
[2] Gas used in manufacture of carbon black included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.
[3] Utah includes North Dakota.

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Improved equipment and technique in utilization of natural gas in industry have brought about greater efficiency in the transfer of heat. A "hot tube" type of combustion apparatus has been developed which eliminates contact between the flue gases and the material being heated. A new industrial outlet for gas may develop from the invention of a new fabric similar to silk and said to be superior in some respects. Natural gas is a principal ingredient.

*Mixed gas.*—The volume of natural gas sold to consumers in 1937 for blending with manufactured gas declined 12 percent to 56 billion cubic feet from a 1936 total of 64 billion. The principal cause of the drop was a change in the Detroit area from the use of mixed to natural gas, which resulted in the transfer of about 400,000 meters to the straight natural-gas classification. The number of consumers in Iowa and Ohio also was reduced slightly in 1937.

Illinois consumes almost 40 percent of the natural gas sold with manufactured gas, as the Chicago metropolitan area is served with mixed gas. New York State is the second largest consumer of mixed gas, which is sold extensively in Buffalo and vicinity.

*Consumption of natural gas used with manufactured gas in the United States in 1937, by States*

| State | Domestic | | Commercial | | Industrial (M cubic feet) | Total | |
|---|---|---|---|---|---|---|---|
| | Consumers | M cubic feet | Consumers | M cubic feet | | M cubic feet | Value at points of consumption |
| California | 5,120 | 233,000 | 400 | 57,000 | 48,000 | 338,000 | $243,000 |
| District of Columbia | 142,800 | 2,757,000 | 6,480 | 274,000 | 427,000 | 3,458,000 | 2,527,000 |
| Illinois | 1,037,410 | 14,535,000 | 48,960 | 3,665,000 | 4,387,000 | 22,587,000 | 23,393,000 |
| Indiana | 29,730 | 377,000 | 1,230 | 76,000 | 34,000 | 487,000 | 540,000 |
| Iowa | 50,770 | 1,226,000 | 3,290 | 205,000 | 76,000 | 1,507,000 | 1,598,000 |
| Kentucky | 70,470 | 2,625,000 | 7,080 | 720,000 | 883,000 | 4,228,000 | 2,157,000 |
| Maryland | 15,280 | 295,000 | 300 | 7,000 | 11,000 | 313,000 | 281,000 |
| Michigan | 45,700 | 1,347,000 | 1,290 | 97,000 | 704,000 | 2,148,000 | 1,867,000 |
| Minnesota | 117,270 | 2,571,000 | 5,770 | 425,000 | 237,000 | 3,233,000 | 3,788,000 |
| Missouri | 220,490 | 2,696,000 | 10,780 | 337,000 | 247,000 | 3,280,000 | 3,256,000 |
| Nebraska | 54,180 | 994,000 | 480 | 73,000 | 141,000 | 1,208,000 | 755,000 |
| New York | 271,380 | 7,833,000 | 23,100 | 1,568,000 | 1,157,000 | 10,558,000 | 8,419,000 |
| Ohio | 150,550 | 386,000 | 14,790 | 125,000 | 104,000 | 615,000 | 368,000 |
| Pennsylvania | 53,080 | 1,237,000 | 2,370 | 236,000 | 118,000 | 1,591,000 | 1,166,000 |
| Virginia | 18,810 | 405,000 | 1,250 | 120,000 | 25,000 | 550,000 | 539,000 |
| Total: 1937 | 2,283,040 | 39,517,000 | 127,570 | 7,985,000 | 8,599,000 | 56,101,000 | 50,897,000 |
| 1936 | 2,600,160 | 43,214,000 | 152,530 | 8,792,000 | 11,532,000 | 63,538,000 | 57,367,000 |

## INTERSTATE SHIPMENTS

Interstate pipe lines carried 687 billion cubic feet of gas across State lines in 1937, an increase of approximately 20 percent over 1936. The volume of the interstate movement equaled 29 percent of total marketed production in 1937, 26 percent in 1936, and 24 percent in 1935.

Texas, Louisiana, and West Virginia, furnished 67 percent of all interstate shipments in 1937 and 69 percent in 1936. Several States of secondary importance as producers of gas increased their share of the total market. Among these, Kentucky and Pennsylvania each transported about 35 percent more gas to other States in 1937 than in 1936, Oklahoma 31 percent, New Mexico 29 percent, and New York 247 percent. Shipments to other States increased in all States except

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those from Colorado, Illinois, Indiana, and Ohio. The movement of a small amount of gas from Utah to Wyoming began in 1937. Substantial increases were reported in transportation of gas from New Mexico to Arizona, New York to Pennsylvania, and Pennsylvania to West Virginia.

Receipts of gas from other States gained moderately in Ohio and Illinois, the most important consumers. Ohio absorbed 82.7 billion cubic feet, of which 73.4 billion came from West Virginia and 8.7 billion from Kentucky. Illinois absorbed 77.6 billion, of which 57 billion came from Texas, 17.4 billion from Louisiana, and 3 billion from Kansas. Shipments into Michigan, which originated chiefly in Texas and Kansas, grew spectacularly from 4 billion in 1936 to 15 billion cubic feet in 1937 owing to the opening of the Detroit market to natural gas late in 1936.

Most Texas gas exports are from the Panhandle area. It will be noted from the following table that large volumes of gas are piped from Louisiana into Texas to serve markets in the eastern part of the State. The position of Kansas is unique among States whose developed gas reserves greatly exceed current needs. Gas piped into Kansas from Texas and Oklahoma has been substantially larger than outgoing volume in every recent year. In 1937 such imports were 56.3 billion cubic feet and exports 43.3 billion.

*Interstate transportation of natural gas in 1937* [1]

| State from which gas was transported | State through which gas was transported | State to which gas was transported | M cubic feet |
|---|---|---|---|
| Colorado | Wyoming | Utah | 2,728,000 |
| | | Wyoming | 153,000 |
| | | | 2,881,000 |
| Indiana | | Illinois | 13,000 |
| | | Kentucky | 89,000 |
| | | Ohio | 1,000 |
| | | | 103,000 |
| Kansas | | Colorado | 421,000 |
| | Missouri | Illinois | 2,973,000 |
| | do | Indiana | 2,892,000 |
| | Illinois | | |
| | Nebraska | Iowa | 7,026,000 |
| | Missouri, Illinois, Indiana | Michigan | 6,028,000 |
| | Nebraska, Iowa | Minnesota | 6,214,000 |
| | | Missouri | 7,783,000 |
| | | Nebraska | 8,460,000 |
| | Nebraska, Iowa | do | 4,000 |
| | | Oklahoma | 573,000 |
| | Nebraska, Iowa | South Dakota | 950,000 |
| | | | 43,324,000 |
| Kentucky | West Virginia, Virginia, Maryland, Indiana | District of Columbia | 3,458,000 |
| | | Illinois | 185,000 |
| | | Indiana | 1,211,000 |
| | West Virginia, Virginia, Maryland, District of Columbia | Maryland | 313,000 |
| | West Virginia, Maryland | do | 65,000 |
| | | Ohio | 1,333,000 |

[1] Includes exports to Canada and Mexico.



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*Interstate transportation of natural gas in 1937*—Continued

| State from which gas was transported | State through which gas was transported | State to which gas was transported | M cubic feet |
|---|---|---|---|
| Kentucky—Continued | West Virginia | Ohio | 7,346,000 |
| | do | Pennsylvania | 17,901,000 |
| | do | do | 26,000 |
| | Virginia | | |
| | Maryland | | |
| | West Virginia | Virginia | 401,000 |
| | do | do | 149,000 |
| | Virginia | | |
| | Maryland | | |
| | District of Columbia | | |
| | | West Virginia | 12,653,000 |
| | | | 45,041,000 |
| Louisiana | Mississippi | Alabama | 15,948,000 |
| | do | do | 10,000 |
| | Alabama | | |
| | Georgia | | |
| | | Arkansas | 24,705,000 |
| | Mississippi | Georgia | 13,865,000 |
| | Alabama | | |
| | Arkansas | Illinois | 17,367,000 |
| | Missouri | | |
| | | Mississippi | 3,369,000 |
| | Arkansas | do | 2,152,000 |
| | do | Missouri | 14,843,000 |
| | do | Tennessee | 13,336,000 |
| | Mississippi | Texas | 47,248,000 |
| | | | 152,843,000 |
| Mississippi | | Alabama | 635,000 |
| | Alabama | Florida | 1,389,000 |
| | do | Georgia | 28,000 |
| | | Louisiana | 3,490,000 |
| | | | 5,542,000 |
| Missouri | | Illinois | 34,000 |
| | Illinois | Indiana | 34,000 |
| | do | Michigan | 75,000 |
| | Indiana | | |
| | | | 143,000 |
| Montana | | North Dakota | 1,641,000 |
| | | South Dakota | 3,505,000 |
| | | | 5,146,000 |
| New Mexico | Texas | Arizona | 12,857,000 |
| | New Mexico | Colorado | 161,000 |
| | Texas | Mexico | 867,000 |
| | New Mexico | | |
| | Arizona | | |
| | | Texas | 6,008,000 |
| | | | 19,893,000 |
| New York | | Canada | 29,000 |
| | | Pennsylvania | 9,925,000 |
| | | | 9,954,000 |
| Ohio | | Indiana | 173,000 |
| | | Kentucky | 2,000 |
| | | West Virginia | 170,000 |
| | | | 345,000 |
| Oklahoma | | Arkansas | 679,000 |
| | Kansas | Illinois | 81,000 |
| | Missouri | | |
| | Kansas | Indiana | 79,000 |
| | Missouri | | |
| | Illinois | | |
| | | Kansas | 27,108,000 |
| | Kansas | Michigan | 165,000 |
| | Missouri | | |
| | Illinois | | |
| | Indiana | | |

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*Interstate transportation of natural gas in 1937*—Continued

| State from which gas was transported | State through which gas was transported | State to which gas was transported | M cubic feet |
|---|---|---|---|
| Oklahoma—Continued | Kansas | Missouri | 10,321,000 |
| | do | Nebraska | 631,000 |
| | | Texas | 1,618,000 |
| | | | 40,682,000 |
| Pennsylvania | New York | Canada | 49,000 |
| | | New York | 38,709,000 |
| | West Virginia | Ohio | 530,000 |
| | | do | 49,000 |
| | | West Virginia | 6,067,000 |
| | | | 45,404,000 |
| Texas | New Mexico | Colorado | 19,928,000 |
| | Oklahoma, Kansas, Missouri | Illinois | 4,329,000 |
| | Oklahoma, Kansas, Nebraska, Iowa | do | 52,628,000 |
| | Oklahoma, Kansas, Missouri, Illinois | Indiana | 4,211,000 |
| | Oklahoma, Kansas, Nebraska, Iowa, Illinois | do | 13,503,000 |
| | Oklahoma, Kansas, Nebraska | Iowa | 14,328,000 |
| | Oklahoma | Kansas | 29,148,000 |
| | | Louisiana | 8,205,000 |
| | | Mexico | 3,923,000 |
| | Oklahoma, Kansas, Missouri, Illinois, Indiana | Michigan | 8,764,000 |
| | Oklahoma, Kansas, Nebraska, Iowa | Minnesota | 6,897,000 |
| | Oklahoma, Kansas | Missouri | 13,650,000 |
| | Oklahoma, Kansas | Nebraska | 7,155,000 |
| | Oklahoma, Kansas, Nebraska, Iowa | do | 4,000 |
| | | New Mexico | 1,612,000 |
| | | Oklahoma | 13,453,000 |
| | Oklahoma, Kansas, Nebraska, Iowa | South Dakota | 1,054,000 |
| | New Mexico, Colorado | Wyoming | 523,000 |
| | | | 203,315,000 |
| Utah | | do | 91,000 |
| West Virginia | | Kentucky | 7,385,000 |
| | | Maryland | 633,000 |
| | | Ohio | 71,856,000 |
| | Kentucky | do | 1,580,000 |
| | | Pennsylvania | 21,060,000 |
| | Virginia, Maryland | do | 65,000 |
| | | | 102,579,000 |
| Wyoming | | Colorado | 1,000 |
| | | Montana | 1,686,000 |
| | | Nebraska | 1,009,000 |
| | | Utah | 7,446,000 |
| | | | 10,142,000 |
| | | | 687,428,000 |

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## PIPE-LINE DEVELOPMENTS

Total mileage of natural-gas pipe lines built in 1938 was only about one-third of that in 1937. No major lines were constructed. Most new lines were laid to connect developed gas reserves to existing transportation systems. A few minor extensions were made to serve new markets.

The largest project reported comprised 53 miles of 18-inch pipe running from Bigelow Hills, Wyo., to Coalville, Utah. It serves principally as an added loop to the main line which supplies the Salt Lake City (Utah) market. Seven short lines were built in Texas, which ranged in length from 11 to 48 miles and most of which provided new outlets for gas fields.

A 14-mile 8-inch line was laid from Merced to Livingston, Calif., and 10 miles of 10-inch pipe were laid in the Montebello oil field. In Oklahoma, 14 miles of 10- and 12-inch line were installed between Cement and Chickasha. The Schuler oil field in Arkansas supplied gas to a 6-inch line to Eldorado, a distance of 18 miles. An extension of 39 miles of 16-inch pipe was made to a major pipe-line system from Ventura, Iowa, to Albert Lea, Minn.

In Pennsylvania 27 miles of 8-inch pipe were installed from the new Summit Hotel gas field to Waynesburg. Twenty-four miles of 16-inch line were laid from Howard to Perrysville, Ohio.

At least 60 percent of the gas lines of 6-inch and larger sizes that were built in 1938 were coupled by means of electric welds. A new technique for making pipe bends in the field attained rather wide favor in 1938. It is called wrinkle bending and involves heating strips of the pipe wall at right angles to the axis of the pipe to facilitate bending. It effects economies over older methods, as less equipment and smaller crews are required and somewhat less time is consumed per bend. A procedure has been developed for relieving the stresses that are normally produced in arc welds because of rapid temperature changes over a wide range. Stronger, more uniform welds result.

It has been found advantageous under certain conditions to build bridges to carry pipe lines across rivers rather than to embed the line below the river. This practice has become particularly important in parts of the Southwest where river channels are variable owing to shifting sands and where the river waters corrode steel pipe.

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# NATURAL GASOLINE

## AND LIQUEFIED PETROLEUM GASES [1]

By G. R. HOPKINS

## SUMMARY OUTLINE


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## NATURAL GASOLINE

In 1938 the natural-gasoline industry, like most branches of the oil-and-gas industry, experienced a satisfactory year from the standpoint of production, stocks, and distribution, but profits were generally disappointing. This was largely because the low prices carried over from 1937 failed to rally until late in the year.

*Salient statistics of the natural-gasoline industry in the United States, 1934–38, in thousands of gallons*

| | 1934 | 1935 | 1936 | 1937 | 1938 [1] | Percent of change in 1938 from 1937 |
|---|---|---|---|---|---|---|
| Production: | | | | | | |
| Appalachian | 58,601 | 61,315 | 65,669 | 72,056 | 67,625 | −6.1 |
| Illinois, Kentucky, and Michigan | 8,570 | 10,106 | 10,361 | 12,319 | 12,812 | +4.0 |
| Oklahoma City | 102,591 | 120,127 | 128,783 | 166,188 | 138,372 | −16.7 |
| Seminole | 95,186 | 97,599 | 115,557 | 121,839 | 118,606 | −2.7 |
| Texas Panhandle | 256,130 | 276,602 | 218,703 | 230,405 | 230,919 | +.2 |
| East Texas | 46,280 | 78,210 | 140,091 | 185,313 | 185,475 | +.1 |
| Rocky Mountain | 58,427 | 53,965 | 65,337 | 74,868 | 79,529 | +6.2 |
| Kettleman Hills | 152,434 | 153,936 | 171,052 | 182,894 | 186,749 | +2.1 |
| Long Beach | 76,147 | 83,653 | 89,366 | 84,297 | 93,209 | +10.6 |
| All other districts | 680,994 | 716,473 | 791,421 | 935,255 | 1,000,018 | +6.9 |
| Total production | 1,535,360 | 1,651,986 | 1,796,340 | 2,065,434 | 2,113,314 | +2.3 |
| Stocks: | | | | | | |
| Total at plants, terminals, and refineries, Jan. 1 | 154,560 | 177,086 | 155,316 | 170,310 | 199,836 | ---------- |
| Total at plants, terminals, and refineries, Dec. 31 | 157,060 / [2] 177,086 | 155,316 | 170,310 | 199,836 | 202,860 | +1.5 |
| Net change | +2,500 | −21,770 | +14,994 | +29,526 | +3,024 | ---------- |
| Total supply [3] | 1,532,860 | 1,673,756 | 1,781,346 | 2,035,908 | 2,110,290 | +3.7 |
| Distribution: | | | | | | |
| Blended at refineries [4] | 1,132,152 | 1,271,760 | 1,367,814 | 1,596,294 | 1,621,704 | +1.6 |
| Run through crude-oil pipe lines in California | 50,652 | 31,290 | 52,500 | 57,708 | 56,658 | −1.8 |
| Exports | 214,242 | 135,366 | 107,058 | 148,428 | 202,230 | +36.2 |
| Direct shipments to consumers | | 116,340 | 139,230 | 143,640 | 137,970 | −3.9 |
| Losses | 135,814 | 119,000 | 114,744 | 89,838 | 91,728 | +2.1 |
| Total distribution | 1,532,860 | 1,673,756 | 1,781,346 | 2,035,908 | 2,110,290 | +3.7 |

[1] Subject to revision.
[2] For comparison with 1935.
[3] Production plus or minus changes in stocks.
[4] Including amounts run through crude-oil pipe lines east of California.

[1] Data for 1938 are preliminary; detailed statistics with final revisions will be released later.



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Production in 1938 was probably about 2,125,000,000 gallons (the preliminary total was 2,113,314,000 gallons), or about 60 million gallons above the final figure for 1937. However, the 1938 production was about 5 percent short of the record totals of 1929 and 1930. Texas failed to displace California as the leading producing State in 1938, as had been predicted, but as the gap between their outputs was closed in the middle of the year it is probable that Texas will be the leader in 1939.

The natural-gasoline industry maintained its position as a source of volatility in refinery gasoline, but at the expense of further reduction of the average vapor pressure and at generally lower prices. Exports of natural gasoline rose in spectacular fashion during 1938, but "direct" sales were lower than in 1937.

The average yield of natural gasoline declined slightly in 1937 but is believed to have increased in 1938 to about 1 gallon per thousand cubic feet of gas treated. The outstanding technical development of the year probably was the construction of a number of recycle plants—

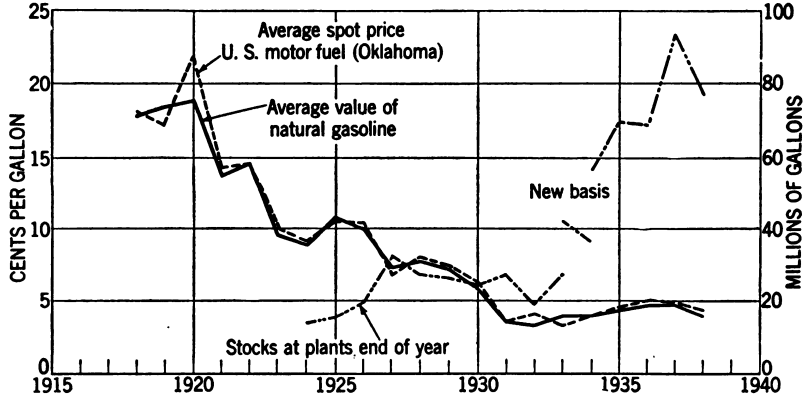


FIGURE 1.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–38.

installations that recover gasoline from so-called distillate wells and return the residue gas to the producing formations. Adjunctive to this development were improvements in the absorption process involving higher pressures and advanced refrigeration.

## PRICES AND MARKET CONDITIONS

The price levels for natural gasoline were generally disappointing in 1938, although the fact that closing quotations on December 31 were higher than those at the first of the year was encouraging. The opening price of a representative grade of natural gasoline (26–70 in Oklahoma) was 3.00 cents per gallon on January 1, reached the year's low of 2.00 cents in February, and started a definite recovery in July which was maintained for the remainder of the year.

As shown in figure 1, the average value of natural gasoline has been below that of the cheapest grade of U. S. Motor gasoline in Oklahoma since about 1934. In 1938 the price differential widened to about 0.5 cent per gallon from about 0.2 cent in 1937, indicating a set-back for natural gasoline in competition with certain light refinery products.

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*Spot price of Mid-Continent natural gasoline, grade 26–70, on specified dates in 1938, with monthly and yearly averages, in cents per gallon*

[National Petroleum News]

| Date | Cents | Date | Cents | Date | Cents |
|---|---|---|---|---|---|
| Jan. 1 | 3.00 | May 2 | 2.50 | Sept. 6 | 3.25 |
| 3 | 3.00 | 9 | 2.13 | 12 | 3.25 |
| 10 | 3.00 | 16 | 2.00 | 19 | 3.25 |
| 17 | 3.00 | 23 | 2.00–2.13 | 26 | 3.00 |
| 24 | 2.50–2.63 | 31 | 2.13 | Average | 3.19 |
| 31 | 2.38 | Average | 2.16 | Oct. 3 | 2.75 |
| Average | 2.79 | June 6 | 2.13 | 10 | 2.75–3.00 |
| Feb. 7 | 2.25–2.38 | 13 | 2.13 | 17 | 2.75–3.00 |
| 14 | 2.00 | 20 | 2.13 | 24 | 2.75–3.00 |
| 21 | 2.00 | 27 | 2.25 | 31 | 2.75–3.00 |
| 28 | 2.13–2.25 | Average | 2.16 | Average | 2.85 |
| Average | 2.13 | July 5 | 2.38 | Nov. 7 | 2.75–3.00 |
| Mar. 7 | 2.38–2.50 | 11 | 2.63 | 14 | 3.00 |
| 14 | 2.50 | 18 | 2.63 | 21 | 3.13–3.25 |
| 21 | 2.50 | 25 | 3.00 | 28 | 3.25–3.38 |
| 28 | 2.50–2.63 | Average | 2.66 | Average | 3.09 |
| Average | 2.50 | Aug. 1 | 3.00 | Dec. 5 | 3.25–3.50 |
| Apr. 4 | 2.50 | 8 | 3.25 | 12 | 3.63–3.75 |
| 11 | 2.50–2.63 | 15 | 3.25 | 19 | 3.75 |
| 18 | 2.50 | 22 | 3.25 | 27 | 3.75 |
| 25 | 2.50 | 29 | 3.25 | Average | 3.64 |
| Average | 2.52 | Average | 3.20 | Average: 1938 | 2.74 |
| | | | | 1937 | 3.69 |

## EMPLOYMENT AND PRODUCTIVITY

The number of natural-gasoline plants has declined in recent years, but up to January 1, 1938, the capacity and number of workers employed increased steadily. This capacity (measured biennially) gained about 15 percent in the 2-year period, 1936–37. The average number of workers rose from 9,198 in 1936 to 9,429 in 1937, a gain of 3 percent. A loss of 5 percent or more in employment in 1938 is anticipated.

Part-time employment at natural-gasoline plants is relatively unimportant; in fact, many companies apparently never have part-time workers. The total number of part-time workers declined from 1,008 in 1936 to 734 in 1937, probably owing to a reduction in men engaged in new construction and replacement.

The hours per week of full-time workers at natural-gasoline plants are virtually the same as those of oil-field workers. In 1936 the average was 40.1 hours per week and in 1937, 41.3. The part-time employees worked about half the time—that is, nearly 1,000 hours a year. The production of natural gasoline increased more rapidly in 1937 than the number of man-hours of work, hence average productivity increased. The average productivity per man-hour in 1937 was 106.6 gallons compared with 99.6 gallons in 1936.

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*Employment at natural-gasoline plants, natural gasoline produced, and average output per man-hour in the United States, 1936–37, by States* [1]

| State | Average number of workers | | Natural-gasoline production (thousands of gallons) | | Labor productivity (gallons per man-hour) | |
|---|---|---|---|---|---|---|
| | 1936 | 1937 | 1936 | 1937 | 1936 | 1937 |
| Arkansas | 99 | 90 | 11,957 | 11,285 | 57.2 | 62.7 |
| California | 1,728 | 1,720 | 593,416 | 623,894 | 183.7 | 183.8 |
| Colorado | 11 | 10 | 451 | 404 | 18.8 | 18.4 |
| Illinois | 56 | 46 | 2,337 | 2,567 | 19.8 | 24.2 |
| Kansas | 209 | 242 | 37,775 | 57,026 | 102.6 | 113.6 |
| Kentucky | 56 | 58 | 6,009 | 7,344 | 57.2 | 65.0 |
| Louisiana | [2] 401 | 320 | 72,687 | 106,415 | 116.3 | 185.7 |
| Michigan | 21 | 19 | 2,015 | 2,408 | 42.9 | 57.3 |
| Montana | 16 | 9 | 2,071 | 2,296 | 50.5 | 88.3 |
| New Mexico | 96 | 120 | 28,921 | 38,253 | 148.3 | 154.9 |
| Ohio | 113 | 92 | 6,991 | 7,704 | 29.7 | 36.2 |
| Oklahoma | [2] 2,600 | 2,660 | 418,591 | 492,290 | 78.4 | 88.8 |
| Texas | [2] 2,790 | 3,125 | 520,547 | 615,281 | 94.8 | 94.7 |
| West Virginia | 559 | 520 | 44,389 | 50,379 | 41.6 | 46.6 |
| Wyoming | 227 | 208 | 33,894 | 33,915 | 73.8 | 82.3 |
| New York and Pennsylvania | 216 | 190 | 14,289 | 13,973 | 29.2 | 33.3 |
| Total, United States | [2] 9,198 | 9,429 | 1,796,340 | 2,065,434 | 99.6 | 106.6 |

[1] Figures for 1938 not yet available. [2] Revised figures.

## PRODUCTION

*Trends in total output.*—Except in 1933, when the East Texas field upset a number of precedents, the trend of natural-gasoline production over the last decade has conformed closely to that of crude-oil production. (See fig. 2.) In 1938, however, the output of crude oil declined 5 percent, whereas that of natural gasoline gained 2 percent. Increased yields in 1938 were no doubt responsible for this anomaly, although curtailment in crude-oil production is not followed generally by as large a decline in the output of casinghead gas.

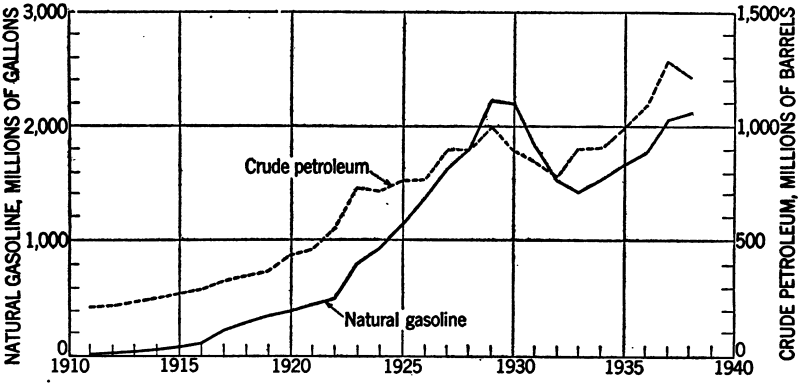


FIGURE 2.—Annual production of natural gasoline and crude petroleum, 1911–38.

The trend in daily average output of natural gasoline in 1938 was generally downward until August and September, after which an upward swing brought the average at the end of the year to just about what it was on January 1.

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*Monthly production of natural gasoline in the United States, 1937–38, by fields, in millions of gallons*

| Field | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| Appalachian | 6.9 | 7.0 | 7.8 | 6.4 | 5.5 | 4.5 | 4.3 | 4.3 | 5.0 | 6.5 | 6.6 | 7.2 | 72.0 |
| Illinois, Kentucky, and Michigan | 1.0 | .9 | 1.1 | 1.0 | 1.0 | .9 | .9 | .9 | 1.0 | 1.2 | 1.3 | 1.1 | 12.3 |
| Oklahoma: | | | | | | | | | | | | | |
| Oklahoma City | 13.1 | 11.7 | 12.0 | 12.7 | 13.2 | 12.4 | 14.9 | 15.3 | 16.6 | 15.5 | 14.4 | 14.4 | 166.2 |
| Osage County | 4.3 | 3.9 | 4.6 | 4.6 | 4.9 | 4.8 | 4.8 | 4.8 | 5.0 | 5.1 | 4.7 | 4.6 | 56.1 |
| Seminole | 8.2 | 8.2 | 9.9 | 10.0 | 10.7 | 10.4 | 10.7 | 10.8 | 10.8 | 11.3 | 10.3 | 10.5 | 121.8 |
| Rest of State | 10.7 | 10.3 | 11.9 | 12.1 | 12.3 | 12.1 | 12.5 | 12.7 | 13.0 | 13.7 | 13.1 | 13.8 | 148.2 |
| Total, Oklahoma | 36.3 | 34.1 | 38.4 | 39.4 | 41.1 | 39.7 | 42.9 | 43.6 | 45.4 | 45.6 | 42.5 | 43.3 | 492.3 |
| Kansas | 4.8 | 4.8 | 4.8 | 4.9 | 4.7 | 4.2 | 4.5 | 4.4 | 4.7 | 4.9 | 5.2 | 5.1 | 57.0 |
| Texas: | | | | | | | | | | | | | |
| Gulf Coast | 2.6 | 2.4 | 2.7 | 2.8 | 3.0 | 3.1 | 3.2 | 3.7 | 3.6 | 3.6 | 3.6 | 3.7 | 38.0 |
| East Texas | 10.9 | 12.6 | 13.4 | 15.2 | 15.9 | 16.9 | 18.2 | 18.6 | 17.7 | 17.2 | 14.1 | 14.6 | 185.3 |
| North Texas | 2.0 | 2.1 | 2.4 | 2.3 | 2.2 | 2.1 | 2.1 | 2.0 | 2.0 | 2.2 | 2.1 | 2.1 | 25.6 |
| Panhandle | 18.1 | 16.5 | 18.0 | 18.1 | 17.9 | 16.1 | 18.0 | 20.1 | 20.8 | 22.6 | 22.1 | 22.1 | 230.4 |
| West-Central | 5.5 | 5.4 | 6.0 | 5.7 | 5.8 | 5.5 | 5.8 | 5.8 | 6.1 | 6.4 | 6.2 | 6.0 | 70.2 |
| Rest of State | 4.2 | 4.4 | 4.9 | 5.0 | 5.5 | 5.4 | 6.1 | 6.4 | 6.2 | 6.1 | 5.7 | 5.9 | 65.8 |
| Total, Texas | 43.3 | 43.4 | 47.4 | 49.1 | 50.3 | 49.1 | 53.4 | 56.6 | 56.4 | 58.1 | 53.8 | 54.4 | 615.3 |
| Louisiana | 8.0 | 7.7 | 7.6 | 8.5 | 8.4 | 9.0 | 9.4 | 9.3 | 9.5 | 9.9 | 9.6 | 9.5 | 106.4 |
| Arkansas | .9 | .8 | .9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | .9 | .9 | .8 | 1.1 | 11.3 |
| Rocky Mountain | 5.6 | 5.3 | 5.8 | 5.8 | 6.0 | 5.8 | 6.6 | 6.7 | 7.1 | 7.1 | 6.5 | 6.6 | 74.9 |
| California: | | | | | | | | | | | | | |
| Huntington Beach | 3.3 | 3.1 | 3.5 | 3.5 | 3.6 | 3.5 | 3.6 | 3.5 | 3.4 | 3.5 | 3.4 | 3.4 | 41.3 |
| Kettleman Hills | 16.9 | 14.8 | 15.8 | 14.6 | 14.8 | 14.5 | 15.3 | 15.9 | 15.0 | 15.3 | 15.0 | 15.0 | 182.9 |
| Long Beach | 7.1 | 6.4 | 7.2 | 7.2 | 7.6 | 7.2 | 7.4 | 7.2 | 7.0 | 6.8 | 6.5 | 6.7 | 84.3 |
| Santa Fe Springs | 5.0 | 4.6 | 5.2 | 5.2 | 5.5 | 5.4 | 5.5 | 5.6 | 5.4 | 5.5 | 5.4 | 5.6 | 63.9 |
| Ventura Avenue | 5.2 | 4.9 | 5.4 | 4.8 | 4.8 | 4.6 | 4.7 | 4.8 | 4.6 | 5.0 | 5.4 | 5.7 | 59.9 |
| Rest of State | 14.7 | 13.9 | 15.5 | 15.0 | 15.4 | 15.3 | 16.1 | 16.4 | 16.2 | 17.5 | 17.3 | 18.3 | 191.6 |
| Total, California | 52.2 | 47.7 | 52.6 | 50.3 | 51.7 | 50.5 | 52.6 | 53.4 | 51.6 | 53.6 | 53.0 | 54.7 | 623.9 |
| Total, United States | 159.0 | 151.7 | 166.4 | 166.4 | 169.7 | 164.7 | 175.6 | 180.2 | 181.6 | 187.8 | 179.3 | 183.0 | 2,065.4 |
| Daily average | 5.1 | 5.4 | 5.4 | 5.5 | 5.5 | 5.5 | 5.7 | 5.8 | 6.1 | 6.1 | 6.0 | 5.9 | 5.7 |
| 1938 [1] | | | | | | | | | | | | | |
| Appalachian | 7.3 | 6.3 | 6.8 | 5.8 | 5.0 | 4.1 | 3.8 | 4.1 | 4.6 | 5.6 | 6.6 | 7.6 | 67.6 |
| Illinois, Kentucky, and Michigan | 1.1 | 1.0 | 1.0 | .9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 | 1.4 | 12.8 |
| Oklahoma: | | | | | | | | | | | | | |
| Oklahoma City | 13.6 | 11.5 | 13.7 | 11.8 | 12.3 | 11.2 | 10.9 | 10.7 | 10.3 | 12.0 | 10.6 | 9.8 | 138.4 |
| Osage County | 4.3 | 3.7 | 4.2 | 3.9 | 4.1 | 4.0 | 4.2 | 4.3 | 4.5 | 5.0 | 4.2 | 4.5 | 50.9 |
| Seminole | 10.5 | 10.0 | 10.6 | 10.3 | 10.1 | 9.0 | 9.0 | 10.0 | 9.9 | 10.4 | 9.4 | 9.4 | 118.6 |
| Rest of State | 14.2 | 12.9 | 14.0 | 13.2 | 13.5 | 12.5 | 13.0 | 12.8 | 12.9 | 13.8 | 13.7 | 14.1 | 160.6 |
| Total, Oklahoma | 42.6 | 38.1 | 42.5 | 39.2 | 40.0 | 36.7 | 37.1 | 37.8 | 37.6 | 41.2 | 37.9 | 37.8 | 468.5 |
| Kansas | 5.0 | 4.6 | 4.4 | 4.7 | 4.2 | 4.2 | 3.6 | 3.9 | 4.2 | 4.7 | 5.1 | 5.5 | 54.1 |
| Texas: | | | | | | | | | | | | | |
| Gulf Coast | 3.1 | 3.1 | 4.6 | 4.6 | 5.1 | 5.4 | 6.2 | 6.7 | 6.1 | 6.2 | 5.7 | 5.5 | 62.3 |
| East Texas | 14.8 | 13.3 | 16.2 | 15.7 | 15.2 | 15.5 | 18.3 | 17.4 | 14.6 | 15.8 | 14.3 | 14.4 | 185.5 |
| North Texas | 2.1 | 1.9 | 2.1 | 2.2 | 2.2 | 2.1 | 2.1 | 2.1 | 2.2 | 2.3 | 2.1 | 2.2 | 25.6 |
| Panhandle | 21.7 | 18.0 | 19.9 | 19.5 | 18.7 | 17.4 | 17.4 | 18.4 | 17.8 | 19.3 | 20.6 | 22.2 | 230.9 |
| West-Central | 6.0 | 5.3 | 6.1 | 5.6 | 5.6 | 5.5 | 5.9 | 5.9 | 5.5 | 6.1 | 6.0 | 6.1 | 69.6 |
| Rest of State | 5.8 | 5.7 | 6.6 | 6.7 | 6.7 | 6.6 | 7.6 | 7.8 | 7.2 | 7.5 | 6.8 | 7.0 | 82.0 |
| Total, Texas | 53.5 | 47.3 | 55.5 | 54.3 | 53.5 | 52.5 | 57.5 | 58.3 | 53.4 | 57.2 | 55.5 | 57.4 | 655.9 |
| Louisiana | 7.8 | 7.1 | 6.7 | 7.0 | 7.4 | 7.2 | 7.1 | 6.7 | 7.1 | 7.4 | 7.3 | 7.9 | 86.7 |
| Arkansas | 1.8 | 1.7 | 2.0 | 2.0 | 1.8 | 1.8 | 1.8 | 2.4 | 2.2 | 2.4 | 2.1 | 2.2 | 24.2 |
| Rocky Mountain | 6.2 | 5.7 | 6.1 | 5.9 | 6.7 | 6.4 | 6.9 | 6.9 | 6.8 | 7.6 | 7.1 | 7.2 | 79.5 |
| California: | | | | | | | | | | | | | |
| Huntington Beach | 3.6 | 3.3 | 3.7 | 3.5 | 3.7 | 3.5 | 3.7 | 3.6 | 3.4 | 3.6 | 3.4 | 3.5 | 42.5 |
| Kettleman Hills | 16.0 | 14.0 | 16.0 | 15.3 | 15.5 | 14.9 | 14.8 | 16.2 | 15.8 | 16.1 | 16.2 | 15.9 | 186.7 |
| Long Beach | 6.8 | 6.6 | 7.5 | 7.7 | 8.3 | 8.0 | 8.5 | 8.3 | 7.9 | 8.1 | 7.7 | 7.8 | 93.2 |
| Santa Fe Springs | 5.6 | 5.0 | 5.5 | 5.4 | 5.7 | 5.3 | 5.3 | 5.2 | 5.1 | 5.2 | 5.0 | 5.0 | 63.3 |
| Ventura Avenue | 5.3 | 4.7 | 4.5 | 4.5 | 4.8 | 4.6 | 4.5 | 4.5 | 4.5 | 5.0 | 5.1 | 5.3 | 57.3 |
| Rest of State | 19.5 | 17.9 | 19.5 | 19.0 | 18.6 | 17.8 | 17.7 | 18.6 | 17.8 | 18.5 | 18.1 | 18.0 | 221.0 |
| Total, California | 56.8 | 51.5 | 56.7 | 55.4 | 56.6 | 54.1 | 54.5 | 56.4 | 54.5 | 56.5 | 55.5 | 55.5 | 664.0 |
| Total, United States | 182.1 | 163.3 | 181.7 | 175.2 | 176.2 | 168.0 | 173.3 | 177.5 | 171.4 | 183.8 | 178.3 | 182.5 | 2,113.3 |
| Daily average | 5.9 | 5.8 | 5.9 | 5.8 | 5.7 | 5.6 | 5.6 | 5.7 | 5.7 | 5.9 | 5.9 | 5.9 | 5.8 |

[1] Subject to revision.

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*California.*—Production in California continued the annual increase begun in 1934, the output in 1938 being 664,000,000 gallons (6 percent above 1937). The actual increase may have been as high as 8 percent, because the 1938 figures are subject to material revision.

The chief factor affecting natural-gasoline production in California in 1938 was the degree of curtailment in crude-oil production. Strenuous efforts of the proration committees were rewarded with some decreases in crude-oil production in the middle and last quarter of the year, after which natural-gasoline production declined accordingly. The older fields of California just about held their own in production in 1938, Long Beach being a notable exception.

*Louisiana.*—Owing to the decline in output of the Rodessa oil field natural-gasoline production in Louisiana fell to 86,700,000 gallons in 1938 from 106,400,000 gallons in 1937. The crude-oil output of the State increased, but the gain was in the coastal fields where there are few natural-gasoline plants and where most of the gas is wasted.

*Oklahoma.*—Production decreased 5 percent in 1938, or from 492,300,000 gallons in 1937 to 468,500,000 in 1938. The "Rest of State", composed of many small fields outside the three major areas, increased its output but not enough to offset the material loss at Oklahoma City.

*Texas.*—Production in Texas continued to increase, the total of 655,800,000 gallons in 1938 being 7 percent above the previous peak in 1937. Although the Texas total for 1938 was slightly below that of California, indications are that Texas already has become the leading producing State, as it surpassed California in monthly output the middle of the year.

In 1938 production in the Panhandle and East Texas, the two leading districts, was virtually the same as in 1937. The output increased in "Rest of State" and in the Gulf Coast district, where considerable natural gasoline is produced incident to recycling operations.

*Natural gasoline produced in the United States, 1934–38, by States, in thousands of gallons*

| Year | Arkansas | California | Colorado | Illinois | Kansas | Kentucky | Louisiana | Michigan | Montana | New Mexico |
|---|---|---|---|---|---|---|---|---|---|---|
| 1934 | 13,033 | 506,272 | 643 | 3,810 | 27,891 | 4,171 | 40,558 | 589 | 1,237 | 21,748 |
| 1935 | 13,076 | 534,624 | 417 | 2,642 | 32,507 | 5,614 | 49,732 | 1,850 | 1,739 | 19,563 |
| 1936 | 11,957 | 593,416 | 451 | 2,337 | 37,775 | 6,009 | 72,687 | 2,015 | 2,071 | 28,921 |
| 1937 | 11,285 | 623,894 | 404 | 2,567 | 57,026 | 7,344 | 106,415 | 2,408 | 2,296 | 38,253 |
| 1938 [1] | 24,235 | 663,992 | 320 | 2,455 | 54,133 | 6,997 | 86,693 | 3,360 | 1,767 | 47,453 |

| Year | New York | Ohio | Oklahoma | Pennsylvania | Texas | West Virginia | Wyoming | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Thousands of gallons | Value at plant | |
| | | | | | | | | | Thousands of dollars | Average per gallon (cents) |
| 1934 | 85 | 5,881 | 355,438 | 10,781 | 466,570 | 41,854 | 34,799 | 1,535,360 | 60,523 | 3.9 |
| 1935 | 27 | 6,232 | 379,913 | 12,623 | 516,748 | 42,433 | 32,246 | 1,651,986 | 70,940 | 4.3 |
| 1936 | 22 | 6,991 | 418,591 | 14,267 | 520,547 | 44,389 | 33,894 | 1,796,340 | 84,572 | 4.7 |
| 1937 | 33 | 7,704 | 492,290 | 13,940 | 615,281 | 50,379 | [2] 33,915 | 2,065,434 | 97,125 | 4.7 |
| 1938 [1] | 28 | 7,379 | 468,460 | 10,685 | 655,835 | 49,533 | 29,989 | 2,113,314 | 78,195 | 3.7 |

[1] Subject to revision. [2] Includes Utah.

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*Other States.*—Production in most of the other producing States decreased in 1938, Arkansas and New Mexico being the chief exceptions. In Arkansas the discovery of deep oil production has greatly increased the available supply of casinghead gas, and the output in 1938 was more than double that in 1937. Michigan increased production in 1938, but Illinois proved an exception to the general rule that natural-gasoline output follows the general trend of crude-oil yield. The output of crude oil in Illinois in 1938 was more than 200 percent higher than in 1937, yet the production of natural gasoline declined, because the gas-oil ratios of the new fields are relatively low; furthermore, most of the production is so scattered that the companies burn it in flares rather than go to the expense of piping it.

*Natural gasoline produced and natural gas treated in the United States in 1937, by States* [1]

| State | Number of operators [2] | Number of plants operating | Natural gasoline produced | | | Natural gas treated | |
|---|---|---|---|---|---|---|---|
| | | | Thousands of gallons | Value at plants | | Millions of cubic feet | Average yield per M cubic feet (gallons) |
| | | | | Thousands of dollars | Average per gallon (cents) | | |
| Arkansas | 7 | 9 | 11,285 | 577 | 5.1 | 4,031 | 2.80 |
| California | 33 | 94 | 623,894 | 37,719 | 6.0 | 381,568 | 1.64 |
| Colorado | 2 | 2 | 404 | 16 | 4.0 | 153 | 2.64 |
| Illinois | 19 | 49 | 2,567 | 153 | 6.0 | 1,027 | 2.50 |
| Kansas | 13 | 21 | 57,026 | 2,192 | 3.8 | 153,416 | .37 |
| Kentucky | 4 | 7 | 7,344 | 382 | 5.2 | 34,981 | .21 |
| Louisiana | 19 | 30 | 106,415 | 4,300 | 4.0 | 144,474 | .74 |
| Michigan | 2 | 2 | 2,408 | 103 | 4.3 | 1,381 | 1.74 |
| Montana | 1 | 1 | 2,296 | 161 | 7.0 | 9,062 | .25 |
| New Mexico | 4 | 5 | 38,253 | 1,493 | 3.9 | 61,625 | .62 |
| New York | 1 | 1 | 33 | 2 | 6.1 | 50 | .66 |
| Ohio | 6 | 11 | 7,704 | 460 | 6.0 | 33,625 | .23 |
| Oklahoma | 53 | 139 | 492,290 | 20,272 | 4.1 | 338,007 | 1.46 |
| Pennsylvania | 56 | 96 | 13,940 | 701 | 5.0 | 31,508 | .44 |
| Texas | 63 | 135 | 615,281 | 24,329 | 4.0 | 754,696 | .82 |
| Utah | | | 367 | 19 | 5.2 | | |
| West Virginia | 24 | 86 | 50,379 | 2,528 | 5.0 | 140,512 | .36 |
| Wyoming | 5 | 8 | 33,548 | 1,718 | 5.1 | 18,684 | 1.82 |
| Total: 1937 | [3] 249 | 696 | 2,065,434 | 97,125 | 4.7 | 2,108,800 | .98 |
| 1936 | [3] 263 | 700 | 1,796,340 | 84,572 | 4.7 | 1,815,000 | .99 |

[1] Complete figures for 1938 not yet available.
[2] A producer operating in more than 1 State is counted only once.

## CONSUMPTION AND MOVEMENTS

The indicated demand or distribution of natural gasoline in 1938 was about 2,110,000,000 gallons—4 percent higher than in 1937. The demand in 1938 was divided as follows: Utilized at refineries, 80 percent; exports, 10 percent; direct shipments to jobbers and retailers, 6 percent; and losses, 4 percent. Compared with similar data for 1937 these ratios indicate chiefly an increase in the importance of exports at the expense of refinery consumption.

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*Distribution of natural gasoline in the United States, 1937–38, by months, in thousands of gallons*

| | January | February | March | April | May | June | July | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| Production | 158,970 | 151,746 | 166,362 | 166,446 | 169,722 | 164,682 | 175,602 | 180,180 | 181,608 | 187,782 | 179,298 | 183,036 | 2,065,434 |
| Decrease in stocks | 966 | | | | | | | | 32,046 | 35,028 | 12,474 | 16,338 | |
| | 159,936 | 151,746 | 166,362 | 166,446 | 169,722 | 164,682 | 175,602 | 180,180 | 213,654 | 222,810 | 191,772 | 199,374 | 2,065,434 |
| Used at refineries[1] | 122,640 | 102,228 | 103,866 | 108,780 | 105,966 | 102,438 | 119,196 | 144,984 | 180,138 | 179,214 | 167,706 | 159,138 | 1,596,294 |
| Run through pipe lines in California | 3,486 | 3,444 | 4,074 | 4,410 | 4,998 | 5,544 | 6,006 | 4,410 | 8,442 | 4,620 | 3,990 | 4,284 | 57,708 |
| Exports[2] | 10,500 | 10,542 | 9,912 | 11,214 | 10,374 | 19,236 | 5,586 | 11,004 | 14,070 | 20,748 | 11,424 | 13,818 | 148,428 |
| Direct shipments to consumers | 11,466 | 10,794 | 12,642 | 16,086 | 11,802 | 11,256 | 10,500 | 10,878 | 13,440 | 11,760 | 11,760 | 11,256 | 143,640 |
| Increase in stocks | | 10,836 | 21,378 | 20,706 | 29,274 | 11,256 | 27,762 | 5,166 | | | | | 29,526 |
| Losses | 11,844 | 13,902 | 14,490 | 5,250 | 7,308 | 14,952 | 6,552 | 3,738 | −2,436 | 6,468 | −3,108 | 10,878 | 89,838 |
| | 159,936 | 151,746 | 166,362 | 166,446 | 169,722 | 164,682 | 175,602 | 180,180 | 213,654 | 222,810 | 191,772 | 199,374 | 2,065,434 |
| 1938[3] | | | | | | | | | | | | | |
| Production | 182,112 | 163,338 | 181,692 | 175,182 | 176,232 | 168,042 | 173,334 | 177,492 | 171,402 | 183,750 | 178,248 | 182,490 | 2,113,314 |
| Decrease in stocks | | | | | | | | | | 58,296 | 43,218 | 38,304 | |
| | 182,112 | 163,338 | 181,692 | 175,182 | 176,232 | 168,042 | 173,334 | 177,492 | 171,402 | 242,046 | 221,466 | 220,794 | 2,113,314 |
| Used at refineries[1] | 145,950 | 111,174 | 130,158 | 114,576 | 112,140 | 105,630 | 119,574 | 115,962 | 135,534 | 181,734 | 173,040 | 176,232 | 1,621,704 |
| Run through pipe lines in California | 3,444 | 3,402 | 5,628 | 5,376 | 5,418 | 5,040 | 3,696 | 7,938 | 4,284 | 4,410 | 4,284 | 3,738 | 56,658 |
| Exports[2] | 7,896 | 21,420 | 9,156 | 19,866 | 21,630 | 20,790 | 10,542 | 13,524 | 8,316 | 29,190 | 18,438 | 21,462 | 202,230 |
| Direct shipments to consumers | 12,096 | 11,928 | 13,020 | 10,206 | 11,130 | 11,508 | 9,702 | 10,164 | 12,054 | 12,600 | 12,684 | 10,878 | 137,970 |
| Increase in stocks | 8,106 | 2,772 | 21,588 | 27,216 | 15,498 | 16,926 | 27,846 | 17,136 | 5,754 | | | | 3,024 |
| Losses | 4,620 | 12,642 | 2,142 | −2,058 | 10,416 | 8,148 | 1,974 | 12,768 | 5,460 | 14,112 | 13,020 | 8,484 | 91,728 |
| | 182,112 | 163,338 | 181,692 | 175,182 | 176,232 | 168,042 | 173,334 | 177,492 | 171,402 | 242,046 | 221,466 | 220,794 | 2,113,314 |

[1] Includes quantities run through pipe lines east of California.

[2] As reported to the Bureau of Mines by manufacturers.

[3] Subject to revision.

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*Refinery utilization.*—The proportion of natural gasoline in refinery gasoline continued to increase, rising to 7.2 percent in 1938 from 7.0 percent in 1937. This does not necessarily mean that the product was more indispensable in refinery operations but simply that the output of producers without refining facilities was absorbed at lower prices.

The two Gulf Coast districts, in which blending increased materially in 1937, used considerably less natural gasoline in 1938. On the other hand, California and Texas Inland, the two districts with the highest blending ratios, used even more natural gasoline in blending in 1938.

*Percentage of natural gasoline blended in refinery gasoline, 1934–38, by districts*

| Year | East coast | Appalachian | Indiana, Illinois, Kentucky | Oklahoma, Kansas, Missouri | Texas Inland | Texas Gulf Coast | Louisiana Gulf Coast | Arkansas and Louisiana Inland | Rocky Mountain | California | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1934 | 1.9 | 2.3 | 4.8 | 10.5 | 12.2 | 2.9 | 1.6 | 6.0 | 9.0 | 16.2 | 6.8 |
| 1935 | 2.0 | 1.6 | 4.1 | 10.1 | 12.5 | 2.7 | 1.8 | 5.7 | 7.9 | 16.1 | 6.7 |
| 1936 | 1.6 | 1.6 | 4.4 | 9.7 | 11.5 | 3.9 | 1.8 | 5.4 | 7.8 | 15.5 | 6.7 |
| 1937 | 1.9 | 1.8 | 4.3 | 8.5 | 13.1 | 5.3 | 4.6 | 6.5 | 6.1 | 15.7 | 7.0 |
| 1938 [1] | 1.6 | 1.4 | 4.7 | 8.8 | 15.5 | 4.3 | 2.2 | 6.8 | 5.8 | 17.6 | 7.2 |

[1] Subject to revision.

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*Natural gasoline blended at refineries in the United States, 1937–38, by districts and months, in thousands of gallons*

| District | January | February | March | April | May | June | July | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1937 | | | | | | | | | | | | | |
| East Coast | 5,376 | 3,654 | 3,360 | 3,234 | 2,352 | 2,058 | 2,142 | 5,460 | 7,644 | 12,852 | 8,484 | 8,064 | 64,680 |
| Appalachian | 1,512 | 1,344 | 1,428 | 1,134 | 1,134 | 840 | 966 | 966 | 1,134 | 1,428 | 1,764 | 1,554 | 15,204 |
| Indiana, Illinois, Kentucky, etc. | 12,810 | 11,634 | 13,020 | 15,414 | 14,322 | 13,062 | 12,684 | 11,970 | 15,414 | 17,430 | 17,766 | 15,708 | 171,234 |
| Oklahoma, Kansas, and Missouri | 22,680 | 19,068 | 16,716 | 15,708 | 15,876 | 15,918 | 16,758 | 21,042 | 26,334 | 27,552 | 24,612 | 22,176 | 244,440 |
| Texas: | | | | | | | | | | | | | |
| Gulf Coast | 13,608 | 12,138 | 11,508 | 15,792 | 19,740 | 15,204 | 19,740 | 31,038 | 44,016 | 32,256 | 33,936 | 33,684 | 282,660 |
| Inland | 17,598 | 16,212 | 19,572 | 15,666 | 16,002 | 16,464 | 20,076 | 23,100 | 23,520 | 25,914 | 23,898 | 26,250 | 244,272 |
| Total, Texas | 31,206 | 28,350 | 31,080 | 31,458 | 35,742 | 31,668 | 39,816 | 54,138 | 67,536 | 58,170 | 57,834 | 59,934 | 526,932 |
| Louisiana-Arkansas: | | | | | | | | | | | | | |
| Louisiana Gulf Coast | 1,092 | 966 | 1,344 | 1,302 | 1,638 | 2,562 | 4,116 | 4,158 | 5,880 | 5,292 | 4,200 | 2,520 | 35,070 |
| Arkansas and Louisiana Inland | 1,932 | 1,722 | 1,470 | 1,722 | 1,722 | 2,520 | 2,772 | 3,192 | 3,444 | 4,242 | 3,234 | 2,730 | 30,702 |
| Total, Louisiana-Arkansas | 3,024 | 2,688 | 2,814 | 3,024 | 3,360 | 5,082 | 6,888 | 7,350 | 9,324 | 9,534 | 7,434 | 5,250 | 65,772 |
| Rocky Mountain | 3,822 | 2,772 | 2,688 | 2,478 | 1,848 | 1,302 | 1,596 | 1,722 | 2,772 | 4,452 | 5,250 | 3,990 | 34,692 |
| California [1] | 42,546 | 36,162 | 36,834 | 40,740 | 36,330 | 38,052 | 44,352 | 46,746 | 58,422 | 52,416 | 48,552 | 46,746 | 527,898 |
| Total, United States | 122,976 | 105,672 | 107,940 | 113,190 | 110,964 | 107,982 | 125,202 | 149,394 | 188,580 | 183,834 | 171,696 | 163,422 | 1,650,852 |
| 1938 [2] | | | | | | | | | | | | | |
| East Coast | 5,754 | 3,654 | 4,620 | 2,520 | 1,932 | 2,772 | 2,310 | 3,360 | 5,712 | 5,544 | 5,628 | 6,510 | 50,316 |
| Appalachian | 1,176 | 966 | 798 | 672 | 714 | 756 | 924 | 1,092 | 966 | 966 | 1,092 | 1,176 | 11,298 |
| Indiana, Illinois, Kentucky, etc. | 15,414 | 12,348 | 14,658 | 12,348 | 13,104 | 11,970 | 14,448 | 12,474 | 18,060 | 20,748 | 23,352 | 19,572 | 188,496 |
| Oklahoma, Kansas, and Missouri | 21,882 | 19,614 | 21,966 | 15,036 | 15,162 | 15,540 | 16,464 | 17,598 | 24,444 | 28,560 | 24,318 | 21,840 | 242,424 |
| Texas: | | | | | | | | | | | | | |
| Gulf Coast | 29,064 | 12,768 | 17,430 | 20,496 | 17,976 | 15,540 | 19,278 | 17,808 | 14,364 | 27,720 | 29,274 | 32,928 | 254,646 |
| Inland | 23,226 | 24,276 | 22,092 | 20,748 | 22,470 | 21,462 | 20,034 | 19,950 | 21,084 | 26,460 | 29,400 | 27,048 | 278,250 |
| Total, Texas | 52,290 | 37,044 | 39,522 | 41,244 | 40,446 | 37,002 | 39,312 | 37,758 | 35,448 | 54,180 | 58,674 | 59,976 | 532,896 |
| Louisiana-Arkansas: | | | | | | | | | | | | | |
| Louisiana Gulf Coast | 2,142 | 1,764 | 2,310 | 1,554 | 1,008 | 630 | 714 | 1,008 | 1,302 | 840 | 1,470 | 1,302 | 16,044 |
| Arkansas and Louisiana Inland | 2,478 | 2,688 | 2,478 | 2,016 | 2,310 | 2,352 | 2,982 | 2,898 | 2,856 | 3,192 | 2,814 | 1,890 | 30,954 |
| Total, Louisiana-Arkansas | 4,620 | 4,452 | 4,788 | 3,570 | 3,318 | 2,982 | 3,696 | 3,906 | 4,158 | 4,032 | 4,284 | 3,192 | 46,998 |
| Rocky Mountain | 3,696 | 3,318 | 3,192 | 2,100 | 1,302 | 966 | 1,344 | 1,344 | 2,436 | 4,200 | 5,040 | 4,788 | 33,726 |
| California [1] | 44,562 | 33,180 | 46,242 | 42,462 | 41,580 | 38,682 | 44,772 | 46,368 | 48,594 | 67,914 | 54,936 | 62,916 | 572,208 |
| Total, United States | 149,394 | 114,576 | 135,786 | 119,952 | 117,558 | 110,670 | 123,270 | 123,900 | 139,818 | 186,144 | 177,324 | 179,970 | 1,678,362 |

[1] Includes natural gasoline run through pipe lines.

[2] Subject to revision.

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*"Direct" sales.*—Although it might seem that the low refinery prices would have spurred producers to market low-vapor-pressure material direct to consumers, the quantity sold to jobbers and retailers declined from 143,640,000 gallons in 1937 to 137,970,000 in 1938. On the other hand, shipments to refinery-owned bulk plants increased from 27,869,000 gallons in 1937 to 39,270,000 in 1938.

The largest single interstate movement of natural gasoline to consumers other than refiners continued to be that from Oklahoma to Illinois; and the largest intrastate movement, that within Texas. Both movements increased in 1938 over 1937. "Direct" sales in Arkansas increased materially in 1938, whereas those in Kansas showed a severe decline.

*Shipments of natural gasoline to jobbers, retailers, and refinery-owned bulk plants in the United States in 1938, by States, in thousands of gallons* [1]

| State from which natural gasoline was transported | State to which natural gasoline was transported | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Texas | Illinois | Ohio | Oklahoma | Minnesota | Wisconsin | Other States | |
| Texas | 37,633 | 2,455 | 169 | 547 | 8,346 | 4,776 | 7,058 | 60,984 |
| Oklahoma | 1,034 | 13,507 | 429 | 13,877 | 3,017 | 5,344 | 6,526 | 43,734 |
| West Virginia | | | 9,419 | | | | 14,407 | 23,826 |
| Arkansas | | 8 | | | 8 | | 12,086 | 12,102 |
| Louisiana | 32 | 868 | | 1,025 | 64 | 118 | 4,717 | 6,824 |
| Ohio | | | 4,842 | | | | 1,112 | 5,954 |
| Kansas | | 466 | 49 | 1,392 | 975 | 818 | 1,519 | 5,219 |
| Other States | 704 | 630 | 2,449 | | 40 | 738 | 14,036 | 18,597 |
| | 39,403 | 17,934 | 17,357 | 16,841 | 12,450 | 11,794 | 61,461 | 177,240 |

[1] Subject to revision.

*Water-borne shipments.*—Data reported to the Bureau of Mines by manufacturers indicate total exports of 202,230,000 gallons (4,815,000 barrels) in 1938 compared with 148,428,000 gallons in 1937. The figures of the Bureau of Foreign and Domestic Commerce for exports are 3,738,000 barrels for 1937 and 6,114,000 for 1938. The sizable difference in the respective totals for 1938 probably represents natural gasoline mixed with crude oil for export, a practice that is reported to have grown rapidly in 1938. Exports of natural gasoline from California in 1938 remained about the same as in 1937, hence the large gain was recorded in exports from the Gulf. Shipments for blending at refineries in Netherland West Indies comprised the largest single item in 1938, with exports to United Kingdom, France, and Canada following in that order. Japan took 384,000 barrels in 1938 but Germany and Italy together only 64,000 barrels. About 70 percent of the total exports of natural gasoline in 1938 passed through the Galveston (including Houston) customs district.

## STOCKS

Substantial withdrawals in the last 3 months of 1938 eased the stock situation, as the total rose only about 3,000,000 gallons—from 199,836,000 gallons on January 1 to 202,860,000 gallons on December 31. The gain was in refinery stocks, as stocks at plants and terminals declined about 16,000,000 gallons. More specifically, the responsibility for the increase rests with refinery stocks in California, which

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rose from about 82,000,000 gallons on January 1 to about 109,000,000 on December 31. Stocks at other points apparently reached unprecedented low levels, at least in terms of days' supply, which should be a helpful factor throughout 1939.

*Stocks of natural gasoline in the United States, 1937–38, by months, in thousands of gallons*

| Date | At refineries | | | | At plants and terminals | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | California | | Other States | | Texas | | Other States | | | |
| | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] | 1937 | 1938 [1] |
| Jan. 1 | 75,768 | 81,774 | 25,914 | 24,654 | 45,423 | 57,988 | 23,205 | 35,420 | 170,310 | 199,836 |
| Jan. 31 | 81,564 | 86,604 | 25,074 | 20,874 | 41,412 | 61,233 | 21,294 | 39,231 | 169,344 | 207,942 |
| Feb. 28 | 87,864 | 98,196 | 23,394 | 25,746 | 44,284 | 47,159 | 24,638 | 39,613 | 180,180 | 210,714 |
| Mar. 31 | 94,542 | 103,362 | 22,512 | 28,518 | 52,916 | 59,625 | 31,588 | 40,797 | 201,558 | 232,302 |
| Apr. 30 | 97,734 | 108,780 | 20,538 | 26,964 | 66,845 | 74,600 | 37,147 | 49,174 | 222,264 | 259,518 |
| May 31 | 105,630 | 118,398 | 18,900 | 24,570 | 79,151 | 77,410 | 47,857 | 54,638 | 251,538 | 275,016 |
| June 30 | 110,082 | 129,360 | 22,512 | 24,696 | 75,905 | 77,595 | 54,295 | 60,291 | 262,794 | 291,942 |
| July 31 | 111,342 | 134,358 | 29,862 | 25,284 | 85,409 | 96,756 | 63,943 | 63,390 | 290,556 | 319,788 |
| Aug. 31 | 108,024 | 136,752 | 33,474 | 27,090 | 89,255 | 110,698 | 64,969 | 62,384 | 295,722 | 336,924 |
| Sept. 30 | 90,384 | 138,726 | 45,150 | 26,544 | 77,856 | 122,584 | 50,286 | 54,824 | 263,676 | 342,678 |
| Oct. 31 | 83,706 | 123,732 | 35,658 | 23,268 | 68,792 | 98,278 | 40,492 | 39,104 | 228,648 | 284,382 |
| Nov. 30 | 82,362 | 120,624 | 29,778 | 18,732 | 69,632 | 71,896 | 34,402 | 29,912 | 216,174 | 241,164 |
| Dec. 31 | 81,774 | 108,696 | 24,654 | 17,136 | 57,988 | 48,397 | 35,420 | 28,631 | 199,836 | 202,860 |

[1] Subject to revision.

## TECHNICAL DEVELOPMENTS

*Yields.*—The upward trend in yields was arrested in 1937 when the national average was 0.98 gallon per thousand cubic feet compared with 0.99 gallon in 1936. However, indications are that the average yield will increase to at least 1.00 gallon in 1938, despite a decrease in average vapor pressure. The average yield in California and Texas, the two leading producers, gained in 1937 but not enough to overcome losses in Oklahoma and New Mexico.

*Production by processes.*—The number of straight compression plants continued to decline, but the production by this process (including vapor rectification) continued to rise. Production by the absorption (and combination) methods increased materially in 1937, and the process gave no evidence of decreasing in popularity. The number of charcoal plants was one less (10 to 9), and the total production by this method decreased after an unexpected gain in 1936.

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*Natural gasoline produced in the United States in 1937, by States and by methods of manufacture*[1]

| State | Number of plants operating | | | Production (thousands of gallons) | | |
|---|---|---|---|---|---|---|
| | Compression | Absorption [2] | Charcoal | Compression | Absorption [2] | Charcoal |
| Arkansas | | 9 | | | 11,285 | |
| California | 3 | 91 | | 8,622 | 615,272 | |
| Colorado | 1 | 1 | | 143 | 261 | |
| Illinois | 49 | | | 2,567 | | |
| Kansas | 6 | 15 | | 2,271 | 54,755 | |
| Kentucky | 4 | 2 | 1 | 1,616 | 5,112 | 616 |
| Louisiana | 4 | 26 | | 3,236 | 103,179 | |
| Michigan | 1 | 1 | | 34 | 2,374 | |
| Montana | | 1 | | | 2,296 | |
| New Mexico | | 5 | | | 38,253 | |
| New York | 1 | | | 33 | | |
| Ohio | 4 | 6 | 1 | 37 | 6,432 | 1,235 |
| Oklahoma | 35 | 104 | | 40,832 | 451,458 | |
| Pennsylvania | 83 | 12 | 1 | 2,912 | 10,853 | 175 |
| Texas | 24 | 111 | | 126,890 | 488,391 | |
| Utah | | | | | [3] 367 | |
| West Virginia | 59 | 21 | 6 | 12,163 | 31,648 | 6,568 |
| Wyoming | 3 | 5 | | 27,063 | 6,485 | |
| Total: 1937 | 277 | 410 | 9 | 228,419 | 1,828,421 | 8,594 |
| 1936 | 286 | 404 | 10 | 213,188 | 1,573,904 | 9,248 |

[1] Figures for 1938 not yet available.
[2] Includes combination of absorption process with compression and charcoal processes.
[3] Drip gasoline.

*Trends in vapor pressures.*—The weighted average vapor pressure of all shipments of natural gasoline continued to decline, falling to 19.6 pounds in 1938 from 20.0 pounds in 1937. The decrease was chiefly in refinery shipments, as the average vapor pressure of exports rose 0.1 pound (17.1 to 17.2 pounds) while that of "direct" shipments fell only 0.1 pound (15.7 to 15.6 pounds). The downward trend in vapor pressures reflects the constant effort required to keep natural gasoline a primary source of volatility at refineries. Unfortunately, reducing the butane content to make a more stable product generally lowers the octane rating, hence the interest of the industry in such matters as compression ratios, volatility specifications, and carburetor design.

*Technical improvements.*—No figures on polymerization were collected in 1938, but it is safe to say that application of the process expanded materially. However, most of the expansion was at refineries, that at natural-gasoline plants remaining the exception. The desire to maintain the position of natural gasoline in the octane race was the prime motive in experiments by which isopentane, a high-octane product, was made from natural gasoline by polymerization. The idea apparently has possibilities, but its application is still in the experimental stage.

Probably the most important improvements in established methods were those permitting the use of much higher pressures in the absorbers. This development was of particular significance where the gas was returned to the sand. Higher yields at absorption plants are being obtained by advanced refrigeration, through which the lean oil is cooled by the expansion of butane-propane mixtures.

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## LIQUEFIED PETROLEUM GASES [2]

Despite uncertain economic conditions during 1938, sales of liquefied petroleum gases continued to gain although at a lower rate than in recent years. Domestic deliveries in 1938 were 165,201,000 gallons compared with 141,400,000 gallons (revised) in 1937.

*Sales of liquefied petroleum gases, 1933–38, in thousands of gallons*

| Year | Propane | Butane | Propane-butane mixtures | Pentane | Total |
|---|---|---|---|---|---|
| 1933 | 15,835 | 19,056 | 3,226 | 814 | 38,931 |
| 1934 | 18,681 | 25,553 | 10,271 | 1,922 | 56,427 |
| 1935 | 26,814 | 34,084 | 13,493 | 2,464 | 76,855 |
| 1936 | 36,502 | 40,200 | 27,375 | 2,575 | 106,652 |
| 1937 | 46,474 | [1] 45,399 | 46,694 | 2,833 | [1] 141,400 |
| 1938 [2] | 54,130 | 52,768 | 56,050 | 2,253 | 165,201 |

[1] Revised figures. [2] Subject to revision.

All principal uses for liquefied petroleum gases were greater in 1938 than in 1937 except deliveries for industrial fuel, which declined in 1938 owing to generally curtailed manufacturing operations. Sales of liquefied petroleum gases for domestic consumption expanded noticeably in 1938, increasing 42 percent as the advantages of this type of fuel for cooking, heating, air conditioning, refrigeration, power, and lighting for the home, the farm, the camp, and the small establishment became known more widely. Requirements for chemical manufacturing and internal-combustion-engine fuel mounted more than 20 percent in 1938 compared with 1937, while sales of liquefied petroleum gases to gas-manufacturing companies in 1938 were 11 percent above the 1937 total. Exports of liquefied petroleum gases continued the decline of recent years and were reported as 825,000 gallons in 1938 compared with 1,984,000 gallons in 1937 and 5,125,000 gallons in 1936. The marketed production of liquefied petroleum gases, including both domestic and export deliveries, totaled 166,026,000 gallons in 1938, or 16 percent over the 1937 requirements of 143,384,000 gallons.

In 1938, as in 1937, total deliveries of liquefied petroleum gases were divided about equally among propane, butane, and propane-butane mixtures, while pentane sales remained relatively unimportant. Propane sales of 54,130,000 gallons in 1938 were 16 percent above the 1937 total of 46,474,000 gallons, while butane deliveries of 52,768,000 gallons in 1938 likewise were 16 percent more than in 1937. The market for propane-butane mixtures increased from 46,694,000 gallons in 1937 to 56,050,000 in 1938, or 20 percent. Sales of pentane, which declined for the first year since 1933, were reported as 2,253,000 gallons in 1938 compared with 2,833,000 in 1937.

A review of 1938 sales of liquefied petroleum gases reveals that the domestic or "bottled-gas" demand took the lead over industrial-fuel requirements. Domestic sales of 57,832,000 gallons in 1938 represent 35 percent of total deliveries compared to 29 percent in 1937. It should be noted, however, that this reversal in the market demand probably is temporary, as 1938 was a year of retarded ac-

[2] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

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tivity in manufacturing. Consequently requirements for industrial fuel were somewhat below normal, as shown by deliveries of 38,849,000 gallons in 1938—10 percent less than the 1937 total of 43,310,000 gallons. The extent of the decline in the use of liquefied petroleum gases in 1938 for industrial fuel is illustrated further by the fact that this particular use constituted about 31 percent of the total demand in 1937 but less than 24 percent in 1938.

Sales of liquefied petroleum gases to gas-manufacturing companies for direct resale through their mains or for mixture with other gases increased 11 percent in 1938 to a total of 12,386,000 gallons. Deliveries for this use, however, declined from 7.9 percent of the marketed production in 1937 to 7.5 percent in 1938. Sales of liquefied petroleum gas credited to chemical manufacturing were 32,299,000 gallons in 1938, or 21 percent over 1937 sales of 26,792,000 gallons, but the 1938 increase was much less than that in 1937, when sales for this purpose virtually doubled the 1936 quantity (14,445,000 gallons). The steady growth in the sale of liquefied petroleum gases for use as fuel in internal-combustion engines continued in 1938, when 20,914,000 gallons were delivered—a gain of 23 percent over the 1937 demand of 16,987,000 gallons. Liquefied petroleum gases have proved quite satisfactory as fuel in heavy-duty automotive equipment and power engines, so further development along this line may be expected.

The market for propane increased from 46,474,000 gallons in 1937 to 54,130,000 gallons in 1938. In 1938, as in previous years, the bulk of the propane was delivered for domestic consumption, the quantity increasing from 30,436,000 gallons in 1937 to 37,556,000 in 1938. Propane sold for industrial fuel declined slightly from 14,490,000 gallons in 1937 to 14,316,000 in 1938, while that delivered for gas manufacturing increased noticeably from 1,077,000 gallons in 1937 to 1,491,000 in 1938.

Sales of butane increased 16 percent—from 45,399,000 gallons in 1937 to 52,768,000 in 1938. Butane is in greatest demand as an industrial fuel where temperature control in manufacturing processes is important; however, because of the slower industrial pace in 1938, this use declined from 28,071,000 gallons in 1937 to 23,405,000 in 1938. The domestic consumption of butane, which doubled in 1937 compared with 1936, continued the sharp upward trend in 1938, when sales increased to 13,194,000 gallons from 6,047,000 in 1937. It is also of interest that domestic use ranked second as an outlet for butane in 1938, supplanting gas manufacturing which dropped to third place. The rapid growth in the domestic demand for butane is confined largely to the South Central States, where petroleum refineries and gasoline plants furnish a ready supply. Butane predominates in deliveries of liquefied petroleum gases to gas-manufacturing companies, and 8,270,000 gallons of this gas were sold for gas manufacturing in 1938 compared with 7,325,000 gallons in 1937. Sales for this use in 1938 were exceeded only by deliveries of butane for industrial and domestic consumption. The use of butane as fuel in internal-combustion engines gained sharply in 1938, when 5,025,000 gallons were reported compared with 1,715,000 gallons in 1937. Furthermore the percentage of butane in internal-combustion-engine fuel increased from 10 percent in 1937 to 24 percent in 1938.

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Propane-butane mixtures are important as solvents and raw material to chemical manufacturers who buy more than half of the marketed production. Data released now for the first time show that the demand for propane-butane mixtures for use in chemical manufacturing totaled 12,223,000 gallons in 1936 and doubled to 24,601,000 gallons in 1937. The increase was not as spectacular in 1938 owing to adverse economic conditions; however, 30,496,000 gallons of propane-butane mixtures were absorbed in the manufacture of chemicals during the year. Propane-butane mixtures make an ideal internal-combustion-engine fuel under some conditions of service and load, and developments in that direction have made rapid progress. Sales of propane-butane mixtures for motor fuel increased from 14,994,000 gallons in 1937 to 15,509,000 in 1938, the larger share of the demand in both years being reported for the Pacific Coast States. Propane-butane mixtures are relatively unimportant as a domestic fuel; however, sales for that use increased from 3,504,000 gallons in 1937 to 6,316,000 in 1938.

Pentane sales declined from 2,833,000 gallons in 1937 to 2,253,000 in 1938. The consumption of pentane by chemical plants dropped from 1,907,000 gallons in 1937 to 1,413,000 in 1938, and domestic sales fell from 836,000 gallons in 1937 to 766,000 in 1938.

The American Gas Association has cooperated in the current annual survey of the marketed production of liquefied petroleum gases by reporting the pertinent details of the distribution by gas companies as follows:

At the end of 1938, liquefied petroleum gas was being delivered through mains to consumers in 193 communities in 31 States by 80 companies supplying 38,400 customers.

Butane-air gas with heating value ranging from 520 to 900 B. t. u. per cubic foot was supplied to 140 communities in 30 States by 70 companies. A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B. t. u. per cubic foot was supplied to 13 communities in California by 5 companies. Undiluted propane gas with a heating value of 2,550 B. t. u. per cubic foot was supplied to 40 communities in Maryland, Minnesota, New Jersey, North Dakota, Virginia, and Wisconsin by 6 companies.

A gain from 21 percent in 1937 to 22.5 in 1938 in cylinder or drum shipments of liquefied petroleum gases is associated with the large increase (42 percent) in domestic sales. This is substantiated by the reported data that show cylinder shipments for domestic use of 35,424,000 gallons out of total cylinder shipments for all uses of 37,140,000 gallons in 1938 compared with cylinder shipments for domestic use of 26,097,000 gallons out of total shipments of 29,926,000 gallons in 1937. Largely because of contracted industrial requirements, bulk handling of liquefied petroleum gases in tank cars and tank trucks declined from 78.8 percent of total deliveries in 1937 to 77.5 percent in 1938.

Forty distributors of liquefied petroleum gases reported their sales to the Bureau of Mines in the 1938 survey compared with 33 in 1937. In the Pacific Coast area 11 companies responded to the request compared with 10 in 1937.

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*Sales of liquefied petroleum gases in the United States, 1937–38, by uses, methods of transportation, and regional distribution, in thousands of gallons*

| | Propane | Butane | Propane-butane mixtures | Pentane | Total | Percent |
|---|---|---|---|---|---|---|
| 1937 | | | | | | |
| By uses: | | | | | | |
| Domestic | 30,436 | 6,047 | 3,504 | 836 | 40,823 | [1] 29.0 |
| Gas manufacturing | 1,077 | [1] 7,325 | 2,765 | 8 | [1] 11,175 | [1] 7.9 |
| Industrial fuel | 14,490 | 28,071 | 699 | 50 | 43,310 | 30.6 |
| Chemical manufacturing | 77 | 207 | 24,601 | 1,907 | 26,792 | 18.9 |
| Internal-combustion-engine fuel | 278 | 1,715 | 14,994 | ---------- | 16,987 | 12.0 |
| All other uses | 116 | 2,034 | 131 | 32 | 2,313 | 1.6 |
| | 46,474 | [1] 45,399 | 46,694 | 2,833 | [1] 141,400 | 100.0 |
| Percent of total | 32.9 | 32.1 | 33.0 | 2.0 | 100.0 | ---------- |
| By method of transportation: | | | | | | |
| Bulk | 22,650 | [1] 43,593 | 42,589 | 2,642 | [1] 111,474 | [1] 78.8 |
| Cylinders | 23,824 | 1,806 | 4,105 | 191 | 29,926 | [1] 21.2 |
| | 46,474 | [1] 45,399 | 46,694 | 2,833 | [1] 141,400 | [1] 100.0 |
| Regional distribution: | | | | | | |
| Pacific Coast area | 6,266 | 5,447 | 18,085 | ---------- | 29,798 | 21.1 |
| All other areas | 40,208 | [1] 39,952 | 28,609 | 2,833 | [1] 111,602 | 78.9 |
| | 46,474 | [1] 45,399 | 46,694 | 2,833 | [1] 141,400 | 100.0 |
| 1938 [2] | | | | | | |
| By uses: | | | | | | |
| Domestic | 37,556 | 13,194 | 6,316 | 766 | 57,832 | 35.0 |
| Gas manufacturing | 1,491 | 8,270 | 2,617 | 8 | 12,386 | 7.5 |
| Industrial fuel | 14,316 | 23,405 | 1,112 | 16 | 38,849 | 23.5 |
| Chemical manufacturing | 347 | 43 | 30,496 | 1,413 | 32,299 | 19.5 |
| Internal-combustion engine fuel | 380 | 5,025 | 15,509 | ---------- | 20,914 | 12.7 |
| All other uses | 40 | 2,831 | ---------- | 50 | 2,921 | 1.8 |
| | 54,130 | 52,768 | 56,050 | 2,253 | 165,201 | 100.0 |
| Percent of total | 32.8 | 31.9 | 33.9 | 1.4 | 100.0 | ---------- |
| By method of transportation: | | | | | | |
| Bulk | 22,420 | 50,050 | 53,665 | 1,926 | 128,061 | 77.5 |
| Cylinders and drums | 31,710 | 2,718 | 2,385 | 327 | 37,140 | 22.5 |
| | 54,130 | 52,768 | 56,050 | 2,253 | 165,201 | 100.0 |
| Regional distribution: | | | | | | |
| Pacific Coast area | 6,983 | 8,072 | 20,083 | ---------- | 35,138 | 21.3 |
| All other areas | 47,147 | 44,696 | 35,967 | 2,253 | 130,063 | 78.7 |
| | 54,130 | 52,768 | 56,050 | 2,253 | 165,201 | 100.0 |

[1] Revised figures.

[2] Subject to revision.

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# CARBON BLACK

By G. R. Hopkins and H. Backus

## SUMMARY OUTLINE


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The year 1938 was not a particularly prosperous one for the carbon-black industry. Compared with 1937 domestic sales and exports dropped 20 and 9 percent, respectively. However, the most depress-

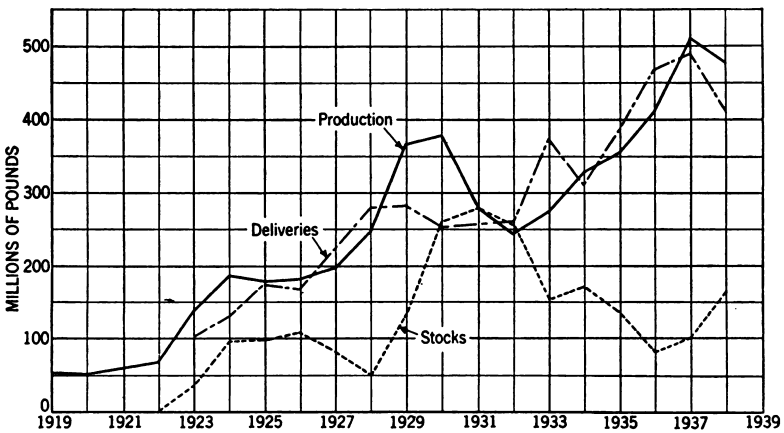


FIGURE 1.—Production, stocks, and deliveries of carbon black, 1919–38.

ing feature was the decline in price; the average f. o. b. plant value fell from 3.41 cents per pound in 1937 to 2.41 cents in 1938. The severe break in prices occurred in the last half of 1937, when rubber consumption was falling rapidly. Recovery in the rubber industry was gradual in 1938, but competitive conditions, plus sharp declines in sales for ink, paint, and miscellaneous uses prevented any substantial late-season rise in carbon-black prices. The situation was complicated further by the insistence of tank-car shippers that the quotations reflect their lower handling costs.

As shown in figure 1, production declined in 1938 for the first time since 1932. Stocks increased substantially in 1938 but at the end of the year were far below the depression peaks of 1930–32.



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*Salient statistics for carbon black made from natural gas in the United States, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Number of producers reporting | 25 | 21 | 20 | 24 | 24 |
| Number of plants | 50 | 54 | 54 | 57 | 55 |
| Quantity produced: | | | | | |
| By States and districts: | | | | | |
| Louisiana, pounds | 66,538,000 | 64,875,000 | 59,201,000 | 66,381,000 | 39,534,000 |
| Texas: | | | | | |
| Panhandle district, do | 237,403,000 | 263,361,000 | 321,576,000 | 405,247,000 | 382,369,000 |
| Rest of State, do | [1] 24,887,000 | [1] 24,513,000 | 12,330,000 | 15,821,000 | 34,735,000 |
| Total Texas, do | [1] 262,290,000 | [1] 287,874,000 | 333,906,000 | 421,068,000 | 417,104,000 |
| Other States, do | (1) | (1) | 18,238,000 | 23,157,000 | 20,401,000 |
| Total United States, do | 328,828,000 | 352,749,000 | 411,345,000 | 510,606,000 | 477,039,000 |
| By processes: | | | | | |
| Channel process, do | 293,546,000 | 316,284,000 | 366,876,000 | 444,427,000 | 441,284,000 |
| Other processes [2], do | 35,282,000 | 36,465,000 | 44,469,000 | 66,179,000 | 35,755,000 |
| Stocks held by producers Dec. 31, pounds | 171,799,000 | 136,086,000 | 79,582,000 | 100,497,000 | 166,159,000 |
| Losses, do | 386,000 | 926,000 | 113,000 | 76,000 | [3] 65,000 |
| Quantity sold: | | | | | |
| Domestic: | | | | | |
| To rubber companies, do | 165,446,000 | 213,708,000 | 278,018,000 | [4] 269,584,000 | 217,231,000 |
| To ink companies, do | 16,146,000 | 15,177,000 | 17,787,000 | 18,116,000 | 14,131,000 |
| To paint companies, do | 5,365,000 | 6,550,000 | 6,914,000 | 6,159,000 | 4,229,000 |
| For miscellaneous purposes, pounds | 5,035,000 | 9,916,000 | 10,299,000 | 11,503,000 | 7,883,000 |
| Total domestic sold, do | 191,992,000 | 245,351,000 | 313,018,000 | [4] 305,362,000 | 243,474,000 |
| Export, do | 120,620,000 | 142,185,000 | 154,718,000 | [4] 184,253,000 | 167,968,000 |
| Total sold, do | 312,612,000 | 387,536,000 | 467,736,000 | 489,615,000 | 411,442,000 |
| Value (at plants) of carbon black produced: | | | | | |
| Total | $11,654,000 | $13,755,000 | $16,110,000 | $17,389,000 | $11,486,000 |
| Average per pound, cents | 3.54 | 3.90 | 3.92 | 3.41 | 2.41 |
| Estimated quantity of natural gas used, M cubic feet | 229,933,000 | 241,589,000 | 283,421,000 | 341,085,000 | 324,950,000 |
| Average yield per M cubic feet, pounds | 1.43 | 1.46 | 1.45 | 1.50 | 1.47 |

[1] Oklahoma and Wyoming included with "Texas: Rest of State."
[2] Lewis, roller, "special," and thermatomic.
[3] Gain.
[4] Revised figures.

## PRODUCTION

*By States, districts, and months.*—The decline in output in 1938 was general throughout all producing States, Oklahoma being the chief exception. Louisiana's output showed a material decrease (40 percent) but that of Texas nearly held its own, dropping only from 421,068,000 pounds in 1937 to 417,104,000 pounds in 1938. Production in the Texas Panhandle declined in 1938 for the first time since 1932, but increased activities in West Texas raised the output in "Rest of State" from 15,821,000 pounds in 1937 to 34,735,000 pounds in 1938.

According to estimates based on monthly figures of the National Gas Products Association, the average daily output of carbon black declined until about midyear then partly recovered under the stimulus of buying at bargain prices.

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*Carbon black produced in the United States, 1934–38, by States*

| Year | Production (thousands of pounds) | | | | Average value per pound (cents) |
|---|---|---|---|---|---|
| | Louisiana | Texas | Other States | Total | |
| 1934 | 66,538 | [1] 262,290 | (1) | 328,828 | 3.54 |
| 1935 | 64,875 | [1] 287,874 | (1) | 352,749 | 3.90 |
| 1936 | 59,201 | 333,906 | [2] 18,238 | 411,345 | 3.92 |
| 1937 | 66,381 | 421,068 | [2] 23,157 | 510,606 | 3.41 |
| 1938 | 39,534 | 417,104 | [2] 20,401 | 477,039 | 2.41 |

[1] Oklahoma and Wyoming included with Texas.
[2] Oklahoma and Wyoming.
[3] Kansas, Oklahoma, and Wyoming.

*Carbon black produced from natural gas in the United States in 1938, by States and by major producing districts*

| State and district | Producers reporting [1] | Number of plants | Production | | | Estimated quantity of natural gas used (M cubic feet) | Average yield per M cubic feet (pounds) |
|---|---|---|---|---|---|---|---|
| | | | Pounds | Value at plant | | | |
| | | | | Total | Average (cents) | | |
| Kansas | 1 | 1 | (2) | (2) | (2) | (2) | (2) |
| Louisiana: Monroe-Richland district (Morehouse Ouachita and Richland Parishes) | 8 | 11 | 39,534,000 | $1,376,000 | 3.48 | 24,143,000 | 1.64 |
| Oklahoma | 2 | 2 | [2] 20,401,000 | [2] 520,000 | [2] 2.55 | [2] 11,151,000 | [2] 1.83 |
| Texas: | | | | | | | |
| Panhandle district (Carson, Gray, Hutchinson, Moore, and Wheeler Counties) | 19 | 33 | 382,369,000 | 8,812,000 | 2.30 | 267,770,000 | 1.43 |
| Rest of State (Eastland, Stephens, Ward, and Winkler Counties) | 5 | 7 | 34,735,000 | 778,000 | 2.24 | 21,886,000 | 1.59 |
| Total, Texas | [1] 19 | 40 | 417,104,000 | 9,590,000 | 2.30 | 289,656,000 | 1.44 |
| Wyoming | 1 | 1 | (2) | (2) | (2) | (2) | (2) |
| Total United States | [1] 24 | 55 | 477,039,000 | 11,486,000 | 2.41 | 324,950,000 | 1.47 |

[1] In counting the total number of producers, a producer operating in more than 1 State, district, or county is counted only once.
[2] Kansas and Wyoming included with Oklahoma.

*Carbon black produced in the United States in 1938, by months, in pounds*

| Month | National Gas Products Association | Bureau of Mines [1] | | Month | National Gas Products Association | Bureau of Mines [1] | |
|---|---|---|---|---|---|---|---|
| | | Total | Daily average | | | Total | Daily average |
| January | 43,091,992 | 46,272,783 | 1,492,670 | August | 36,084,709 | 38,640,159 | 1,246,457 |
| February | 37,437,830 | 40,071,276 | 1,431,117 | September | 35,355,656 | 38,163,120 | 1,272,104 |
| March | 38,449,578 | 41,025,354 | 1,323,399 | October | 37,162,293 | 40,071,276 | 1,292,622 |
| April | 35,406,415 | 38,163,120 | 1,272,104 | November | 35,985,172 | 38,640,159 | 1,288,005 |
| May | 36,564,944 | 39,117,198 | 1,261,845 | December | 37,861,199 | 40,548,315 | 1,308,010 |
| June | 34,608,896 | 37,209,042 | 1,240,301 | | | | |
| July | 36,395,016 | 39,117,198 | 1,261,845 | | 444,403,700 | 477,039,000 | 1,306,956 |

[1] Monthly figures obtained by allocating the Bureau's annual total proportionately to the Association's monthly data.

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*Methods and yields.*—Output by processes other than the regulation channel process dropped from 66,179,000 pounds in 1937 to 35,755,000 pounds in 1938, whereas production by the channel process decreased only from 444,427,000 to 441,284,000 pounds. Apparently the producers of high-yield retort blacks, which comprise the major part of the production of "other types," preferred to lose some of their market rather than meet all cuts in the price of channel black.

The yield of carbon black, which reached a peak of 1.50 pounds per thousand cubic feet in 1937, fell to 1.47 pounds in 1938. Doubtless this decrease was related to the material decline in production by special processes, some of which have relatively high yields.

Research on carbon black by producers and consumers was perhaps intensified in 1938. Much of the research resulted in narrowing the specifications for use of carbon black in rubber. The relative proportion of "dustless" production continued to increase rapidly; and a collateral development, shipments in bulk, grew as fast as finances would permit.

*Number and daily capacity of carbon-black plants operated in the United States, 1937–38, by counties or parishes*

| State | County or parish | Number of plants | | Total daily capacity (pounds) | |
|---|---|---|---|---|---|
| | | 1937 | 1938 | 1937 | 1938 |
| Kansas | Grant | 1 | 1 | (1) | (1) |
| Louisiana | Morehouse | 3 | 2 | 27,550 | 23,850 |
| | Ouachita | 9 | 9 | 225,775 | 225,775 |
| | Richland | 1 | | 3,500 | |
| | | 13 | 11 | 256,825 | 249,625 |
| Oklahoma | Beckham | 1 | 1 | [1] 76,750 | [1] 76,750 |
| | Seminole | 1 | 1 | | |
| | | 2 | 2 | [1] 76,750 | [1] 76,750 |
| Texas | Carson | 1 | 1 | 411,450 | 413,700 |
| | Moore | 6 | 6 | | |
| | Wheeler | 2 | 2 | | |
| | Eastland | 1 | 1 | 107,300 | 107,300 |
| | Stephens | 4 | 4 | | |
| | Ward | 1 | 1 | | |
| | Winkler | 1 | 1 | | |
| | Gray | 10 | 10 | 338,120 | 340,360 |
| | Hutchinson | [2] 14 | [2] 14 | [2] 545,620 | [2] 548,120 |
| | | 40 | 40 | 1,402,490 | 1,409,480 |
| Wyoming | Niobrara | 1 | 1 | (1) | (1) |
| United States | | 57 | 55 | 1,736,065 | 1,735,855 |

[1] Kansas and Wyoming included with Oklahoma.
[2] 1 plant, located in both Carson and Hutchinson Counties, counted in Hutchinson County.

*Number and capacity of plants.*—The construction of new capacity for the manufacture of carbon black was at a standstill in 1938, which was natural in view of the overproduction and low prices. No new plants were built; on the other hand three were removed from the operating list as either dismantled or shut down.

The total capacity of the operating plants remained virtually constant in 1938 at about 1,736,000 pounds daily. A decline of about 7,000 pounds in capacity in Louisiana was compensated by a similar gain in Texas. The ratio of operating capacity to total plant capacity declined from 81 percent in 1937 to 75 percent in 1938.

*Producers.*—Carbon-black producers in 1938 were essentially the same as shown in Minerals Yearbook 1938 except that the Dewdrop

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plant of the United Carbon Co., the Pampa plant of the Magnolia Petroleum Co., and the Pioneer plant of the Peerless Carbon Black Co. were removed from the list as either inoperative or dismantled.

## DEMAND

*Total deliveries.*—Sales of carbon black in 1938 totaled 411,442,000 pounds, 16 percent less than in 1937. Domestic sales in 1938 were 243,474,000 pounds and exports 167,968,000 pounds, indicating a

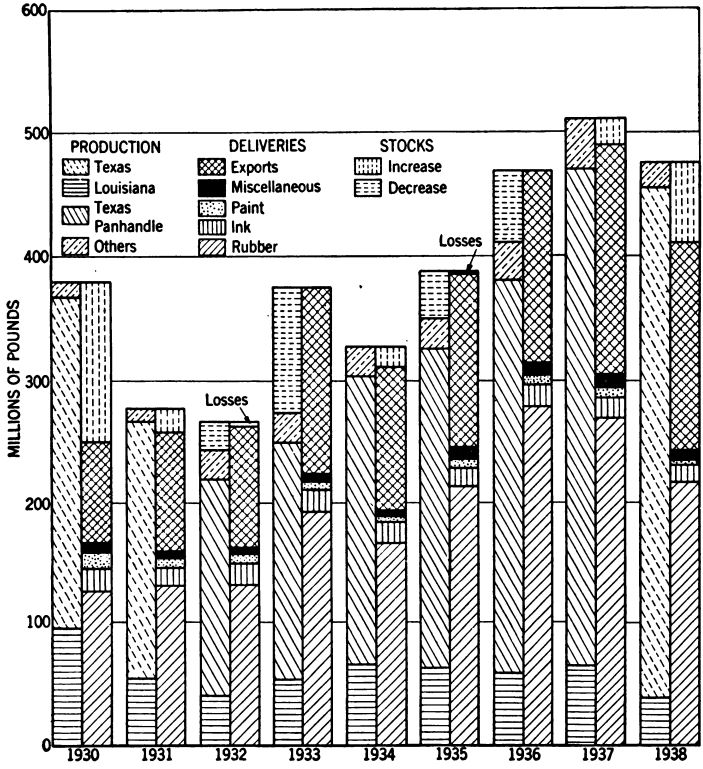


FIGURE 2.—Production and consumption of carbon black, 1930-38.

gain in the relative importance of sales to foreign countries. (See fig. 2.)

*Domestic consumption.*—Domestic sales in 1938 were 20 percent less than in 1937. Reports from producers indicate that domestic sales in 1938 were divided as follows: Rubber companies, 217,231,000 pounds (89 percent); ink companies, 14,131,000 pounds (6 percent); paint companies, 4,229,000 pounds (2 percent); and miscellaneous purposes, 7,883,000 pounds (3 percent). These data indicate chiefly a small increase in the relative importance of sales to rubber companies at the expense of sales for miscellaneous purposes.

According to E. G. Holt, of the Bureau of Foreign and Domestic Commerce, who has again supplied data on rubber consumption, the total consumption of rubber in the United States declined 21 percent in 1938, or from 705,600 long tons in 1937 to 558,800 in 1938. Of the 1938 total, 437,000 long tons was crude rubber, 120,800 reclaimed

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rubber, and 1,000 synthetic rubber. Thus in 1938, as opposed to 1937, the consumption of reclaimed rubber, in which relatively little carbon black is used, decreased more than that of crude rubber. Furthermore, the consumption of latex, another type of rubber requiring little carbon black, declined relatively more in 1938 than that of crude rubber. According to statistics of the Rubber Manufacturers Association, the reduction in output of casings (from 53,300,000 in 1937 to 40,100,000 in 1938) was relatively greater than that in rubber consumption but may have been partly offset by a further increase in the average quantity of carbon black used per casing. Summarizing, the decline in sales of carbon black to rubber companies in 1938 (20 percent) was less than the decline in rubber consumption partly because relatively more crude rubber was used, possibly because the average size of casings increased, and probably because the rubber companies increased their stocks late in the year.

The apparent consumption of crude rubber in the world was 944,000 long tons, 14 percent less than the revised total of 1,103,600 long tons in 1937. These data indicate a further decline in the relative importance of the United States as a manufacturer of rubber in 1938 but a further strengthening of its paramount position as a supplier of carbon black.

The business recession of 1938 was attended by a marked decline in advertising and newsprint consumption, hence consumption of ink declined materially. According to data supplied by B. M. Frost, of the Bureau of Foreign and Domestic Commerce, the supply of newsprint available for domestic consumption in 1938 was 3,089,100 short tons, or 27 percent below 4,260,700 short tons for 1937. Sales of carbon black to ink companies decreased from 18,116,000 pounds in 1937 to 14,131,000 pounds in 1938. Speculative buying of carbon black by ink manufacturers may have caused this decline (22 percent) to be less than the drop in apparent consumption of newsprint.

Sales of carbon black to paint companies dropped from 6,159,000 pounds in 1937 to 4,229,000 in 1938, or 31 percent. This decrease checks reasonably well information supplied by E. C. Wood, Chemicals Division, Bureau of Foreign and Domestic Commerce, to the effect that paint production in 1938 was probably 20 to 25 percent below that in 1937.

Sales of carbon black for miscellaneous purposes fell sharply in 1938—from 11,503,000 pounds in 1937 to 7,883,000 in 1938. No details are available as to the particular sales or uses that declined. Probably the situation is not as dark as the 1938 figures indicate, as favorable results from research have been rumored.

Losses incurred in handling carbon black, which have been declining in recent years, were transformed into a net gain of 65,000 pounds compared with a loss of 76,000 pounds in 1937.

*Exports and imports.*[1]—Exports of carbon black, after inceasing for 3 successive years, declined in 1938, when about 168,000,000 pounds were shipped abroad compared with about 184,000,000 pounds in 1937. The material increase in exports in 1937 was largely the result of military preparations in the totalitarian countries, particularly Germany. However, the decrease in 1938, being quite generally distributed over all the principal importing countries probably reflected a general slump in activity at rubber plants.

[1] Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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Compared with domestic prices foreign quotations held up well; the average export value dropped only 0.21 cent per pound, or from 4.72 cents per pound in 1937 to 4.51 per pound in 1938.

Important gains in exports to foreign countries were notably few in 1938. The outstanding gain of about 40 percent over 1937 was credited to Italy. The United Kingdom continued as the leading foreign customer, with France second and Germany third. Although Germany imported less carbon black from the United States in 1938 than in 1937 it is doubtful if the production of substitutes was responsible. The low prices for carbon black in 1938 were not conducive to the development of substitutes, even in Germany.

An irregular upward trend is noticeable in exports by months for 1938. The highest monthly total, about 18,000,000 pounds, was exported in December and the lowest, about 11,000,000 pounds, in April. Galveston (Houston) further consolidated its position as the leading shipping port in 1938.

*Carbon black exported from the United States, 1936–38, by countries*

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Argentina | 2,214,415 | $120,858 | 3,115,630 | $163,139 | 3,203,142 | $151,669 |
| Australia | 7,525,575 | 365,178 | 9,641,002 | 516,410 | 6,952,545 | 324,118 |
| Belgium | 4,791,552 | 216,690 | 5,164,255 | 234,743 | 5,459,202 | 250,475 |
| Canada | 14,131,366 | 634,911 | 17,171,885 | 719,631 | 13,867,345 | 372,752 |
| China | 1,998,145 | 97,202 | 1,529,855 | 76,878 | 673,498 | 32,230 |
| Czechoslovakia | 258,475 | 10,429 | 2,187,100 | 91,522 | 1,834,572 | 84,395 |
| France | 26,747,904 | 1,195,879 | 29,913,980 | 1,336,934 | 26,216,610 | 1,219,450 |
| Germany | 16,225,511 | 733,491 | 27,441,114 | 1,172,649 | 23,646,635 | 1,076,568 |
| India, British | 752,754 | 31,931 | 1,002,210 | 44,198 | 949,455 | 44,340 |
| Italy | 5,208,663 | 239,276 | 6,956,079 | 300,972 | 9,764,699 | 440,881 |
| Japan | 10,918,380 | 519,919 | 11,929,498 | 619,790 | 9,172,849 | 443,483 |
| Mexico | 1,006,129 | 90,832 | 1,229,597 | 56,438 | 1,396,870 | 44,444 |
| Netherland India | 496,757 | 33,319 | 853,905 | 47,055 | 1,235,515 | 57,142 |
| Netherlands | 2,789,979 | 133,973 | 3,931,601 | 176,132 | 3,643,185 | 174,052 |
| Norway | 459,085 | 24,148 | 453,302 | 23,018 | 560,789 | 28,088 |
| Poland and Danzig | 3,080,158 | 146,531 | 2,175,159 | 103,231 | 3,166,867 | 151,361 |
| Spain | 1,239,449 | 59,476 | 512,200 | 21,252 | 1,332,229 | 59,357 |
| Sweden | 1,425,420 | 92,229 | 1,549,753 | 86,637 | 2,714,415 | 130,083 |
| Union of South Africa | 1,605,210 | 67,290 | 3,155,311 | 128,449 | 1,792,986 | 75,375 |
| United Kingdom | 46,956,730 | 2,163,893 | 48,381,173 | 2,467,609 | 44,429,105 | 2,104,878 |
| Yugoslavia | 22,500 | 994 | 87,600 | 5,193 | 804,735 | 39,803 |
| Other countries | 4,864,241 | 272,255 | 5,870,673 | 308,203 | 5,151,068 | 274,939 |
| | 154,718,398 | 7,250,704 | 184,252,882 | 8,700,083 | 167,968,316 | 7,579,883 |

*Carbon black exported from the United States, 1937–38, by months and customs districts*

| Month | 1937 | | 1938 | | Customs district | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | | Pounds | Value | Pounds | Value |
| Jan. | 13,638,301 | $644,662 | 14,869,135 | $766,764 | Buffalo | 111,589 | $8,891 | 89,711 | $7,997 |
| Feb. | 15,200,283 | 685,630 | 11,083,662 | 493,070 | Dakota | 2,958,355 | 168,184 | 588,073 | 28,312 |
| Mar. | 14,758,714 | 678,877 | 14,814,670 | 654,988 | El Paso | 1,211,100 | 54,251 | 1,344,900 | 38,617 |
| Apr. | 16,880,907 | 747,700 | 10,904,372 | 459,564 | Galveston | 116,735,117 | 5,522,563 | 120,745,454 | 5,533,374 |
| May | 17,952,516 | 837,133 | 16,807,723 | 783,212 | Los Angeles | 671,659 | 37,251 | 349,312 | 14,496 |
| June | 19,276,858 | 844,481 | 12,861,809 | 553,249 | Michigan | 16,510,469 | 682,323 | 13,453,512 | 355,969 |
| July | 13,396,762 | 607,628 | 11,443,234 | 525,217 | New Orleans | 42,638,203 | 2,049,594 | 27,408,556 | 1,404,677 |
| Aug. | 14,754,902 | 771,265 | 12,421,213 | 538,079 | New York | 330,218 | 37,851 | 112,410 | 36,746 |
| Sept. | 14,454,922 | 697,240 | 13,355,141 | 607,181 | Sabine | 2,077,838 | 89,309 | 2,369,513 | 97,018 |
| Oct. | 16,053,820 | 845,780 | 16,629,738 | 776,318 | San Francisco | 565,956 | 29,074 | 1,152,551 | 50,094 |
| Nov. | 15,017,474 | 697,987 | 14,668,039 | 640,315 | Vermont | 329,949 | 15,032 | 192,555 | 4,488 |
| Dec. | 12,867,423 | 641,700 | 18,109,580 | 781,926 | Other districts | 112,429 | 5,760 | 161,760 | 8,095 |
| | 184,252,882 | 8,700,083 | 167,968,316 | 7,579,883 | | 184,252,882 | 8,700,083 | 167,968,316 | 7,579,883 |

Imports of "gas black and carbon black," as reported by the Bureau of Foreign and Domestic Commerce, totaled 390 pounds valued at $30 in 1938 compared with 34 pounds valued at $2 in 1937. Im-

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ports of acetylene black, a competitor for certain uses, declined from 1,309,144 pounds valued at $139,904 in 1937 to 1,220,781 pounds valued at $127,889 in 1938.

## STOCKS

As usual, the decline in demand proceeded faster than that in production, hence stocks increased. Stocks at the plants rose from 100,497,000 pounds the first of the year to 166,159,000 pounds on December 31. Although the gain in stocks was material and weakened the market, it was much less than the annual gains of 1929 and 1930; furthermore, overproduction was corrected to the extent that stocks actually declined in the last quarter of 1938. However, lest this statement be taken too optimistically it should be remarked that rubber manufacturers probably stocked up late in the year in anticipation of higher prices. On the other hand, stocks in the form of finished rubber goods held by manufacturers declined materially—as stocks of casings decreased from about 10,400,000 on December 31, 1937, to about 8,500,000 on December 31, 1938.

## PRICES AND VALUES

Carbon-black prices in 1938 were distressing to producers; they reached unprecedented lows early in the year and never recovered in spite of greatly increased business in the last half of the year. The Zone A spot price declined on January 10 to less than 3 cents per pound, formerly considered the absolute minimum based on costs. On January 17 the price was cut an additional 0.25 cent (to 2.7 cents). It was raised to 2.75 cents on April 4, but this increase (0.05 cent) simply covered increased freight rates.

The weighted average f. o. b. price at plants fell from 3.41 cents in 1937 to 2.41 cents in 1938. The spread between the average spot price and the average value declined from about 0.90 cent per pound in 1937 to 0.34 cent in 1938.

*Quoted prices on various grades of carbon black, 1937–38, in cents per pound*

[Oil, Paint, and Drug Reporter]

| Date | Standard rubber, ink, and paint qualities (carlots) | | | | | | | Special grades for varnishes, lacquers, and enamels (cases delivered) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Zone[1] | | | | | | | Grade | | | | | | |
| | A | B | C | D | E | F | G | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1938: | | | | | | | | | | | | | | |
| Jan. 1 | 3.20 | 3.50 | 3.65 | 3.65 | 3.80 | 4.10 | 4.30 | 5.0 | 8.50 | 13.0 | 27.50 | 40.0 | 60.0 | 110.0 |
| Jan. 10 | 2.95 | 3.25 | 3.40 | 3.40 | 3.55 | 3.85 | 4.05 | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| Jan. 17 | 2.70 | 3.0 | 3.15 | 3.15 | 3.30 | 3.60 | 3.80 | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| Mar. 28 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 3.75 | ------ | ------ | ------ | ------ | ------ | ------ |
| Apr. 4 | 2.75 | 3.10 | 3.19 | 3.25 | 3.41 | 3.75 | 3.0 | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| Average: | | | | | | | | | | | | | | |
| 1938 | 2.75 | 3.09 | 3.20 | 3.24 | 3.40 | 3.73 | 3.22 | 4.04 | 8.50 | 13.0 | 27.50 | 40.0 | 60.0 | 110.0 |
| 1937 | 4.31 | 4.61 | 4.76 | 4.76 | 4.91 | 5.21 | 4.56 | 5.11 | 8.60 | 13.1 | 27.62 | 40.1 | 60.0 | 110.0 |

[1] Zone A: Gulf coast ports: Galveston, Houston, Port Arthur, New Orleans, etc.; for coastwise delivery in North America.
Zone B: Arkansas, Colorado, Kansas, part of Missouri, New Mexico, and Texas except coastal ports.
Zone C: Pacific coast.
Zone D: Illinois, Iowa, and Wisconsin.
Zone E: Florida, Georgia, Indiana, Kentucky, Michigan, Ohio, Tennessee, West Virginia, and parts of New York and Pennsylvania.
Zone F: Atlantic seaboard States: Maine, Maryland, Massachusetts, New Hampshire, New Jersey, North Carolina, parts of New York, Pennsylvania, Rhode Island, South Carolina, Vermont, and Virginia.
Zone G: Mexico.

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# HELIUM

H. S. KENNEDY and C. W. SEIBEL

SUMMARY OUTLINE


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The expectation of wider use of helium has materialized. The act approved September 1, 1937 (50 Stat. 885), authorizes sale by the Bureau of Mines of helium not needed for Government use, upon payment in advance and under regulations approved by the President, for medical, scientific, and commercial use. Regulations were approved by the President on January 14, 1938, and amended with the President's approval on March 10, 1938. As a result of the enactment, helium may be purchased at reasonable prices from the Bureau of Mines, and it is likely that still greater impetus will be given to the use of helium. During the year 1938, the Bureau entered into 20 contracts with private parties for the sale of more than 800,000 cubic feet of helium.

The helium produced at the Bureau of Mines helium plant, Amarillo, Tex., is about 98.2 percent pure. The impurity is largely nitrogen. Under the regulations, the term "contained helium" is used to designate the actual quantity of helium contained in a mixture of that element and other gases. The regulations define the helium sold by the Bureau of Mines as "market helium," and this item is broken down into the specific uses "medical," "scientific," and "commercial." During the last fiscal year one charge was made for helium used for medical and scientific purposes, and a slightly higher charge was made for helium sold for commercial use.

Market helium is sold at approximately the cost of production, with a reasonable charge added to cover items of depreciation and depletion. The Government wishes to make helium available at the lowest reasonable price, and the regulations provide that the helium shall be sold at a price slightly greater than cost. The cost of producing helium varies with the quantity produced; as a result, the exact cost cannot be predetermined, because of the uncertain quantity required by commercial users. Therefore, it is necessary to require deposits in advance of deliveries to protect the Government from possible loss because of increased cost. These deposits are based on estimated charges for the helium itself and an amount to cover services independent of the actual production of helium performed by the Bureau for the purchasers. These service charges include expenses incident to the transportation of cylinders to and from railroad stations, filling cylinders, and repairing them when necessary.



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The estimated cost for market helium for the fiscal year 1938 was $14.25 per thousand cubic feet. To protect the Government in the event of an unlooked-for advance in cost of production, a deposit of $17.10 was required of each purchaser for medical and scientific helium, and if the helium was to be used for commercial purposes, a deposit of $19.15 per thousand cubic feet was required. Under the terms of the regulations, any difference between the deposit (based on estimated cost) and the charges for helium and services (based on actual cost) is refunded to the purchaser at the end of the fiscal year, when the actual cost has been computed. The cost of production for the fiscal year 1938, as approved by the Secretary of the Interior, was $12.83 per thousand cubic feet, which resulted in a charge of $13.47 for helium used for medical and scientific purposes and of $15.08 for helium used commercially.

Pursuant to the Helium Act, helium is furnished to Government agencies on their requisition and payment of a proportional share of the expenses incident to the administration, operation, and maintenance of the properties. The proportionate share paid by Government agencies for the fiscal year 1938 was $11.16 per thousand cubic feet of helium received.

*Uses.*—The major use for helium still is for inflation of nonrigid airships. Both the Army and Navy have airships or observation balloons using helium, and during the past year Congress authorized the building of a new airship for the Navy Department. Moreover, the Goodyear Tire & Rubber Co. has continued to operate several of its small airships, which led to a contract for 500,000 cubic feet of helium during the year.

The use of larger and larger balloons by the Weather Bureau in determining wind direction and in radio-sonde observations for obtaining data used in weather predictions, has caused the replacement of explosive hydrogen with appreciable quantities of helium. Helium now is being furnished to approximately 120 stations of the Weather Bureau, and about 500,000 cubic feet of helium has been used since July 1, 1938, when helium was substituted for hydrogen. The Weather Bureau has expressed the desire to have all its stations use helium during the next fiscal year, which indicates a demand for approximately 1,500,000 cubic feet.

Before helium could be obtained from the Government, it sold at approximately $150 per thousand cubic feet when purchased in small quantities. Such a price made its use for medical purposes, except for wealthy persons, almost prohibitive. Helium can now be purchased from the Government at about one-tenth that selling price. However, helium by itself is not normally used for medical treatment; it is mixed with approximately 20 percent oxygen. The Government is not prepared to mix oxygen with the helium that it produces, and private individuals must purchase such mixtures from commercial distributors. However, it has been estimated that approximately 200,000 cubic feet of helium sold during the calendar year 1938 was used for medical purposes. This quantity of helium, according to authorities on the subject, is enough to furnish 20,000 patient-hours of treatment. Helium mixed with 20 percent oxygen and breathed by persons afflicted with asthma offers almost immediate relief, according to reports from the medical profession.

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Recently a mixture of helium and oxygen has been tested with encouraging results in the treatment of sinus and Eustachian tube blockage. Men working in tunnels are subjected to air pressure before entering the tunnel face, and "blocks" occur in the Eustachian tubes if the men have a stoppage in these tubes due to sinus infection or colds. These tubes must be clear to permit the pressure on the outside and inside of the ear to equalize. If the tubes are not clear, severe pain prevents the men from working under pressure.

Approximately 5,000 cubic feet of helium has been delivered to the National Bureau of Standards for certain specific heat determinations. Small quantities have also been supplied to several universities and institutions for scientific research.

In 1925 the Bureau of Mines published Report of Investigations 2670, Possibilities in the Use of Helium-Oxygen Mixtures as a Mitigation of Caisson Disease, by R. R. Sayers, W. P. Yant, and J. H. Hildebrand and issued a press release in 1926 entitled, "Helium Helps the Diver." These reports dealt with research on the possibility of using helium-oxygen mixtures in deep-sea diving. The Navy Department has continued this research, and others are becoming increasingly interested in this subject. Within the past year new deep-sea diving records have been made possible through the use of helium-oxygen mixtures.

*Cliffside gas field.*—The four gas wells on the Government's Cliffside helium reserve produced a total of 361,065,000 cubic feet of helium-bearing natural gas during the fiscal year 1938, making a cumulative production for the field of 5,053,153,000 cubic feet to June 30, 1938.

*Amarillo plant.*—Although the Bureau of Mines Helium Plant continued to operate on intermittent schedule during the fiscal year 1938, the production of helium was almost 27 percent greater than that of 1937. The helium production for the fiscal year 1938 was 6,099,960 cubic feet, which makes a cumulative production of 84,260,165 cubic feet of helium produced in the plant from the beginning of production in April 1929 to June 30, 1938. During the first half of the current fiscal year, an additional 3,906,975 cubic feet of helium was produced, making a total production of 88,167,140 cubic feet of helium to December 31, 1938.

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# ASPHALT AND RELATED BITUMENS

By A. H. REDFIELD [1]

## SUMMARY OUTLINE


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To meet an 8-percent increase in total demand, domestic and foreign, for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) petroleum refineries in the United States increased their output 3 percent from 1937 to 1938 and reduced their inventories 12 percent from December 31, 1937, to December 31, 1938. The entire increase was in domestic demand as exports of petroleum asphalt were 3 percent less in 1938 than in 1937. Imports of lake asphalt, grahamite, and petroleum asphalt dropped sharply; they comprised only 2 percent of the total demand in 1937 and less than 0.75 percent in 1938. Only 5 percent of the petroleum asphalt produced in the United States was sold to foreign countries in 1937 and only 4 percent in 1938.

*Salient statistics of asphalt and related bitumens in the United States, 1937–38*

| | 1937 | 1938 |
|---|---|---|
| **SUPPLY** | | |
| Native asphalt and related bitumens: | | |
| Produced ..... short tons | 485,384 | 512,147 |
| Imported (chiefly lake asphalt) ..... do | 28,663 | 23,645 |
| Petroleum asphalt (excluding road oil): | | |
| Produced at refineries from— | | |
| Domestic petroleum ..... do | 2,804,121 | 3,068,631 |
| Foreign petroleum ..... do | 1,555,803 | 1,438,245 |
| | 4,359,924 | 4,506,876 |
| Imported ..... | 62,720 | 9,786 |
| Stocks, Jan. 1 ..... do | 364,199 | 557,446 |
| Total supply ..... do | 5,300,890 | 5,609,900 |
| **DISTRIBUTION** | | |
| Native asphalt and related bitumens: | | |
| Indicated domestic demand ..... short tons | 466,849 | 498,601 |
| Exports (unmanufactured) ..... do | 18,535 | 13,546 |
| Petroleum asphalt (excluding road oil): | | |
| Indicated domestic demand (including lake asphalt) ..... do | 4,049,303 | 4,404,846 |
| Exports ..... do | 208,757 | 202,499 |
| Stocks, Dec. 31 ..... do | 557,446 | 490,408 |
| Total distribution ..... | 5,300,890 | 5,609,900 |

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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*Salient statistics of asphalt and related bitumens in the United States, 1937–38*—Continued

| | 1937 | 1938 |
|---|---|---|
| VALUES | | |
| Native asphalt and related bitumens: | | |
| Sales | $3,019,038 | $3,065,260 |
| Imports (chiefly lake asphalt) | 395,882 | 378,209 |
| Exports (unmanufactured) | 720,358 | 543,509 |
| Petroleum asphalt: | | |
| Sales (excluding road oil) from— | | |
| Domestic petroleum | 25,478,565 | 25,948,928 |
| Foreign petroleum | 17,515,872 | 15,432,152 |
| Total sales | 42,994,437 | 41,381,080 |
| Imports | 260,132 | 38,883 |
| Exports | 3,111,127 | 3,030,162 |

## NATIVE ASPHALT AND BITUMENS

*Bituminous rock.*—As a result of an apparent increase in the laying of high-type asphaltic pavements sales of bituminous rock by producers increased from 447,213 short tons valued at $2,035,410 in 1937 to 483,497 tons valued at $2,409,616 in 1938. Rock-asphalt operators in Kentucky and Alabama sold 159,276 tons valued at $865,818 in 1937 and 215,142 tons valued at $1,379,138 in 1938. On the other hand, sales by operators in Texas, Oklahoma, and New Mexico decreased from 265,895 tons valued at $1,075,832 in 1937 to 241,299 tons valued at $939,688 in 1938. Sales by producers in California and Kansas were higher in 1938 than in 1937, but sales in Missouri were slightly lower.

*Gilsonite and wurtzilite.*—Sales of gilsonite by producers in northeastern Utah decreased from 38,038 short tons valued at $973,007 in 1937 to 28,574 tons valued at $649,724 in 1938. A 10-percent increase in railroad freight rates and decreased demand for varnishes and printing ink reduced the domestic demand for gilsonite; higher steamship freight rates and exchange difficulties reduced sales of gilsonite in other countries.

Sales of wurtzilite decreased from 133 tons valued at $10,621 in 1937 to 76 tons valued at $5,920 in 1938.

*Sulfonated bitumen.*—In 1938, as in 1937, a small quantity of natural sulfonated bitumen was produced in Box Elder County, Utah, near Ogden.

*Exports.*—A decrease of 35 percent in demand from Europe, especially from France, Germany, and the United Kingdom, caused exports of natural asphalt and bitumen, unmanufactured, to decline from 18,535 short tons valued at $720,358 in 1937 to 13,546 tons valued at $543,509 in 1938. Of the total exports, 75 percent went to Europe both in 1937 and in 1938; 10 percent went to Canada in 1938 compared with 8 percent in 1937; 2 percent went to South America in 1938 compared with 7 percent in 1937; and 9 percent went to Asia, chiefly Japan, in 1938 compared with 7 percent in 1937.

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## MANUFACTURED OR PETROLEUM ASPHALT

*Production.*—Petroleum refineries produced 3 percent more asphalt in 1938 than in 1937. The total refinery output in 1938 included 165,440 tons of other petroleum products blended with the asphalt to produce commercial varieties of the required consistency.

Of the 1938 production of petroleum asphalt, 32 percent was made from foreign crude imported chiefly from Venezuela and Mexico compared with 36 percent in 1937. Runs of foreign petroleum to stills increased less than 1 percent—from 25,996,000 barrels in 1937 to 26,187,000 in 1938. However, as the recovery of asphalt from foreign crude decreased from 33 percent of foreign crude runs in 1937 to 30 percent in 1938, the production of asphalt from foreign oil decreased 8 percent—from 1,555,803 tons in 1937 to 1,438,245 in 1938. East Coast refineries manufactured 78 percent of their asphalt from foreign crude in 1938 compared with 81 percent in 1937, and Gulf Coast refineries made 16 percent of their asphalt from foreign crude in 1938 compared with 30 percent in 1937. At the same time the production of asphalt from domestic crude increased (especially in the refining districts west of the Mississippi River and in the Appalachian district, in spite of a decline in the Indiana, Illinois, Kentucky, etc., district) from 2,804,121 tons in 1937 to 3,068,631 in 1938.

*Stocks.*—To meet an increase of 355,543 short tons in the indicated domestic demand (offset to a slight extent by a decline of 6,258 tons in export demand) the petroleum refineries of the United States enlarged their output of asphalt 146,952 tons in 1938, while imports of lake asphalt, grahamite, and petroleum asphalt decreased 57,952 tons. Consequently, stocks of asphalt at refineries were 67,038 tons lower on December 31, 1938, than on December 31, 1937, in contrast with an increase of 193,247 tons during 1937. Decreases in asphalt inventories were general east of the Rocky Mountains but were greatest in the Indiana, Illinois, Kentucky, etc., and Louisiana-Arkansas districts.

*Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1938, by districts*

| District | Production | Other petroleum products blended | Receipts from other sources | Stocks | |
|---|---|---|---|---|---|
| | | | | Dec. 31, 1937 | Dec. 31, 1938 |
| | *Short tons* | *Short tons* | *Short tons* | *Short tons* | *Short tons* |
| East Coast | 1,691,540 | 62,226 | 23,834 | 141,738 | 134,136 |
| Appalachian | 113,206 | | 1,928 | 17,877 | 14,789 |
| Indiana, Illinois, Kentucky, etc | 605,710 | 26,867 | 10,730 | 152,766 | 108,897 |
| Oklahoma, Kansas, and Missouri | 341,435 | 1,295 | 7,715 | 56,692 | 40,220 |
| Texas: | | | | | |
| Gulf Coast | 210,156 | | 1 | 14,043 | 15,451 |
| Inland | 195,764 | | 15,521 | 28,146 | 24,863 |
| Total, Texas | 405,920 | | 15,522 | 42,189 | 40,314 |
| Louisiana-Arkansas: | | | | | |
| Louisiana Gulf Coast | 229,750 | 13,002 | 6,346 | 38,080 | 34,068 |
| Arkansas and Louisiana Inland | 193,465 | 10,434 | 3,932 | 36,281 | 16,486 |
| Total, Louisiana-Arkansas | 423,215 | 23,436 | 10,278 | 74,361 | 50,554 |
| Rocky Mountain | 156,961 | 5,667 | 9,762 | 21,973 | 23,096 |
| California | 603,449 | 45,949 | 15,751 | 49,850 | 78,402 |
| Total: 1938 | 4,341,436 | 165,440 | 95,520 | 557,446 | 490,408 |
| 1937 | 4,181,988 | 177,936 | 41,905 | 364,199 | 557,446 |

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*Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1938, by districts*—Continued

| District | Consumption by companies | Transfers and losses | Sales | |
|---|---|---|---|---|
| | | | Quantity | Value |
| | *Short tons* | *Short tons* | *Short tons* | |
| East Coast | 3,640 | 6,818 | 1,774,744 | $18,840,860 |
| Appalachian | 300 | | 117,922 | 1,489,664 |
| Indiana, Illinois, Kentucky, etc. | 21,083 | 13,720 | 652,373 | 6,509,542 |
| Oklahoma, Kansas, and Missouri | 8,474 | 197 | 358,246 | 2,485,080 |
| Texas: | | | | |
| Gulf Coast | 47,936 | 1,518 | 159,295 | 1,412,779 |
| Inland | | | 214,568 | 1,402,950 |
| Total, Texas | 47,936 | 1,518 | 373,863 | 2,815,729 |
| Louisiana-Arkansas: | | | | |
| Louisiana Gulf Coast | 744 | 23,747 | 228,619 | 2,153,334 |
| Arkansas and Louisiana Inland | 6 | 943 | 226,677 | 1,553,073 |
| Total, Louisiana-Arkansas | 750 | 24,690 | 455,296 | 3,706,407 |
| Rocky Mountain | 1,290 | 3,837 | 166,140 | 1,486,292 |
| California | 38,107 | 20,447 | 578,043 | 4,047,506 |
| Total: 1938 | 121,580 | 71,227 | 4,476,627 | 41,381,080 |
| 1937 | 144,467 | 32,162 | 4,031,953 | 42,994,437 |

*Sales.*—Total sales of petroleum asphalt by refineries increased 11 percent in quantity but decreased 4 percent in value from 1937 to 1938. The average value at the refinery of asphalt sold in 1938 was $9.24 per short ton compared with $10.66 in 1937.

Highway construction absorbed more than three-fifths of all asphalt sold in 1938. In general, such statistics as are available indicate an increase in street and road construction in 1938 over 1937. Awards of street and road contracts exceeding $25,000, compiled by the Engineering News-Record, increased 54 percent in value (from $414,537,000 in 1937 to $637,862,000 in 1938)—about 55 percent in volume if allowance is made for a slight decrease in construction costs from 1937 to 1938. The average mileage under construction under the supervision of the Bureau of Public Roads increased from 8,062 in 1937 to 8,140 in 1938. The total mileage of State highways (including Federal-aid roads completed) increased from 30,632 in 1937 to 30,977 in 1938, according to the American Association of State Highway Officials. However, average employment for construction and maintenance of Federal and State highways, as reported to the Bureau of Public Roads, decreased from 281,086 in 1937 to 273,055 in 1938.

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*Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries in the United States in 1938, by varieties*

[Value f. o. b. refinery]

| | From domestic petroleum | | From foreign petroleum | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Solid and semisolid products of less than 200 penetration:[1] | | | | | | |
| Asphalt for: | | | | | | |
| Paving | 793,879 | $6,615,133 | 477,959 | $5,073,578 | 1,271,838 | $11,688,711 |
| Roofing | 463,252 | 4,413,206 | 298,473 | 3,189,638 | 761,725 | 7,602,844 |
| Waterproofing | 14,870 | 167,745 | 47,651 | 520,208 | 62,521 | 687,953 |
| Blending with rubber | 6,394 | 69,536 | 17,420 | 226,484 | 23,814 | 296,020 |
| Briquetting | 56,822 | 597,832 | 919 | 13,416 | 57,741 | 611,248 |
| Mastic and mastic cake | 906 | 7,929 | 611 | 6,245 | 1,517 | 14,174 |
| Pipe coatings | 12,403 | 143,837 | 2,647 | 32,488 | 15,050 | 176,325 |
| Molding compounds | 10,343 | 115,135 | 1,582 | 16,772 | 11,925 | 131,907 |
| Miscellaneous uses | 58,890 | 711,054 | 42,761 | 478,579 | 101,651 | 1,189,633 |
| | 1,417,759 | 12,841,407 | 890,023 | 9,557,408 | 2,307,782 | 22,398,815 |
| Semisolid and liquid products of more than 200 penetration:[1] | | | | | | |
| Flux for: | | | | | | |
| Paving | 121,796 | 839,365 | 71,908 | 658,370 | 193,704 | 1,497,735 |
| Roofing | 307,751 | 2,074,976 | 58,159 | 581,136 | 365,910 | 2,656,112 |
| Waterproofing | 3,239 | 42,810 | 6,190 | 55,710 | 9,429 | 98,520 |
| Cut-back asphalts: | | | | | | |
| Rapid-curing | 538,390 | 5,194,927 | 354,520 | 3,934,335 | 892,910 | 9,129,262 |
| Medium-curing | 476,363 | 3,617,180 | 23,724 | 211,538 | 500,087 | 3,828,718 |
| Emulsified asphalts and fluxes | 43,907 | 550,945 | 13,046 | 127,834 | 56,953 | 678,779 |
| Paints, enamels, japans, and lacquers | 13,218 | 173,121 | 12,204 | 114,766 | 25,422 | 287,887 |
| Other liquid products | 104,540 | 614,197 | 19,890 | 191,055 | 124,430 | 805,252 |
| | 1,609,204 | 13,107,521 | 559,641 | 5,874,744 | 2,168,845 | 18,982,265 |
| Total: 1938 | 3,026,963 | 25,948,928 | 1,449,664 | 15,432,152 | 4,476,627 | 41,381,080 |
| 1937 | 2,476,454 | 25,478,565 | 1,555,499 | 17,515,872 | 4,031,953 | 42,994,437 |

[1] DEFINITIONS

*Paving asphalt.*—Refined asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler, in brick, block, and monolithic pavements.

*Roofing asphalt.*—Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.

*Waterproofing asphalt.*—Asphalt and asphaltic cement used to waterproof and dampproof tunnels, foundations of buildings, retaining walls, bridges, culverts, etc., and for constructing built-up roofs.

*Briquetting asphalt.*—Asphalt and asphaltic cement used to bind coal dust or coke breeze into briquets.

*Mastic and mastic cake.*—Asphalt and asphaltic cement for laying foot pavements and floors, waterproofing bridges, lining reservoirs and tanks, capable of being poured and smoothed by hand troweling.

*Pipe coatings.*—Asphalt and asphaltic cement used to protect metal pipes from corrosion.

*Molding compounds.*—Asphalts used in the preparation of molded composition, such as battery boxes, electrical fittings, push buttons, knobs, handles, etc.

*Miscellaneous uses.*—Asphalt and asphaltic cement used as dips, and in the manufacture of acid-resisting compounds, putty, saturated building paper, fiber board and floor coverings, and not included in the preceding definitions.

*Flux.*—Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.

*Cut-back asphalt.*—Asphalt softened or liquefied by mixing with petroleum distillates.

*Emulsified asphalt and fluxes.*—Asphalts and fluxes emulsified with water for cold-patching, road laying, and other purposes.

*Other liquid products.*—Petroleum asphalt, exclusive of fuel oil used for heating purposes, not included in the preceding definitions.

The increase in mileage of State highways built during 1938 over 1937 was in the higher and intermediate types of surface and in grading and draining operations. Construction of the lighter types of surface declined 7 percent from 1937 to 1938. Asphaltic types (asphaltic concrete, asphaltic macadam, and low-cost bituminous mixtures) gained 22 percent from 1937 to 1938—they constituted 70

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percent of the mileage of higher and intermediate types laid on State highways in 1937 and 78 percent in 1938. On the other hand, the total mileage of portland-cement concrete and of brick and block pavement declined 21 percent from 1937 to 1938.

No comprehensive statistics are available to show the proportions of the various types of surface laid on city and town streets. Apparently there was a general increase in the yardage of municipal street paving, especially in the larger cities, an important but little-recorded field of demand.

Increases in road and street contracts awarded were general throughout the United States but were greatest in the Pacific States, the States lying between the Rocky Mountain front and the Mississippi River, and the Middle Atlantic States. The greatest increase in construction of asphaltic types of pavement was in low-cost bituminous surfaces—from 6,932 miles in 1937 to 9,077 in 1938. Eighty-five percent of this mileage was laid in the less densely populated States west of the Mississippi River and south of the Ohio and Potomac Rivers. A striking increase in the construction of low-cost bituminous surfaces in Indiana raised the proportion of the States bordering the Great Lakes from 10.5 percent of the National total in 1937 to 21 percent in 1938. Asphaltic-macadam paving construction decreased from 574 miles in 1937 to 487 in 1938. Fifty-one percent was laid east of the Mississippi River in 1937 and 80 percent in 1938. Asphaltic-concrete (including sheet-asphalt and natural-rock-asphalt) pavement construction decreased from 1,291 miles in 1937 to 1,137 in 1938. Of this more expensive type of pavement, 87 percent was laid east of the Mississippi River in 1937 and 67 percent in 1938.

Increased construction of high-type, hard-surfaced streets and highways is indicated by a 9-percent gain in sales of paving asphalt of less than 200 penetration from 1,162,497 short tons in 1937 to 1,271,838 in 1938. Gains in sales in the East Coast district—from 625,652 tons in 1937 to 668,301 in 1938—in the Gulf Coast districts of Texas and Louisiana—from 121,258 tons in 1937 to 139,807 in 1938—and in the Inland districts of Texas and Arkansas and Louisiana—from 79,200 tons in 1937 to 154,879 in 1938—more than offset declines in California—from 209,062 tons in 1937 to 190,063 in 1938—and in the Indiana, Illinois, Kentucky, etc., district—from 80,010 tons in 1937 to 67,384 in 1938.

Sales of paving asphalt made from foreign petroleum decreased from 490,873 tons in 1937 to 477,959 in 1938, and sales of paving asphalt made from domestic crude increased from 671,624 tons in 1937 to 793,879 in 1938.

Sales of paving flux increased from 130,616 tons in 1937 to 193,704 in 1938. The principal gains were in the East Coast district (from 48,437 tons in 1937 to 73,635 in 1938) and in California (from 45,418 tons in 1937 to 61,623 in 1938). Smaller gains were recorded in the Indiana, Illinois, Kentucky, etc., district, in Texas, and in the Louisiana-Arkansas district.

Extensive construction of lighter types of surface, both on State highways and secondary roads, as well as continued use of cut-back asphalts, for soil stabilization and revetments, is indicated by a 27-percent increase in sales from 1,099,498 tons in 1937 to 1,392,997 in 1938. The gains were greater west of the Mississippi River; only the Texas Gulf Coast district furnished an exception to the general increase

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over the United States. As in 1937, the greatest increase was in the Oklahoma, Kansas, and Missouri district (from 165,916 tons in 1937 to 253,253 in 1938). This district was followed by the Rocky Mountain district (from 100,341 tons in 1937 to 149,448 in 1938); the Indiana, Illinois, Kentucky, etc., district (from 160,695 tons in 1937 to 205,222 in 1938); the East Coast district (from 393,970 tons in 1937 to 434,599 in 1938); and Inland Texas (from 94,419 tons in 1937 to 138,477 in 1938). Of the major districts producing cut-back asphalts, California made the lowest gain—from 105,812 tons in 1937 to 123,428 in 1938.

The greater increase was in sales of rapid-curing cut-backs—from 673,035 tons valued at $7,948,608 in 1937 to 892,910 valued at $9,129,262 in 1938. At the same time sales of medium-curing cut-backs increased in quantity from 426,463 tons in 1937 to 500,087 in 1938 but declined in value from $4,307,229 to $3,828,718.

The upward trend in sales of asphalt emulsions was interrupted in 1938. Petroleum refineries sold 56,654 tons (13,346,799 gallons) valued at $754,437 in 1937 and 56,953 tons (13,417,238 gallons) valued at $678,779 in 1938. In addition, 49,336,367 gallons valued at $4,339,596 were sold in 1937 and 43,928,186 gallons valued at $3,659,258 in 1938 by six major industrial companies that purchased asphalt from petroleum refineries. Accordingly, total known sales of emulsified asphalts and fluxes decreased in quantity from 62,683,166 gallons in 1937 to 57,345,424 in 1938 and in value from $5,094,033 in 1937 to $4,338,037 in 1938.

Roofing manufacture furnished the second-largest demand for asphalt, absorbing 27 percent of the total sales in 1937 and 25 percent in 1938. A 16-percent rise in shipments of prepared roofing and asphalt siding reported by the Bureau of the Census—from a total of 30,461,447 squares in 1937 to 35,238,029 in 1938—was reflected in a 3-percent rise in sales of roofing asphalt and roofing flux combined—from 1,091,202 tons in 1937 to 1,127,635 in 1938. The principal gains occurred west of the Mississippi River. Texas refineries increased their sales of roofing asphalt and roofing flux from 46,894 tons in 1937 to 92,885 in 1938. Refineries of Louisiana and Arkansas sold 122,290 tons of roofing asphalt and roofing flux combined in 1937 and 132,715 in 1938. In the Oklahoma, Kansas, and Missouri district sales of roofing asphalt and flux increased from 40,328 tons in 1937 to 65,345 in 1938. In California the gain was smaller—from 75,224 tons in 1937 to 77,998 in 1938. On the other hand, refineries of the Indiana, Illinois, Kentucky, etc., district decreased their sales of roofing asphalt and flux from 309,870 tons in 1937 to 289,809 in 1938 and East Coast refineries from 460,984 tons in 1937 to 421,128 in 1938.

A 3-percent decline in the total floor space of both residential and nonresidential contracts awarded, as estimated by the F. W. Dodge Corporation for 37 States, was accentuated in sales of waterproofing asphalt and flux, which decreased from 115,681 tons in 1937 to 71,950 in 1938.

In response to a 13-percent drop in the manufacture of coal briquets, sales of briquetting asphalt fell 9 percent—from 63,767 tons in 1937 to 57,741 in 1938.

The decrease of 11 percent in sales of asphalt for blending with rubber—from 26,713 tons in 1937 to 23,814 in 1938—may be attributed chiefly to a 24-percent decline in the demand for rubber from 1937 to 1938.

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## DOMESTIC DEMAND

The indicated domestic demand for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was 9 percent greater in 1938 than in 1937, increasing from 337,442 short tons per month in 1937 to 367,070 in 1938.

In terms of the long-time trend the indicated demand was 23 percent above the expected demand for 1938, whereas it was 17 percent above the expected demand for 1937; that is, if the national demand had continued the average rate of growth it manifested from 1908 to 1936 it would have averaged 289,136 tons a month in 1937 and 297,864 in 1938. If these averages are used as a standard of comparison, the indicated demand of 337,442 tons a month in 1937 was 117 percent of the expected demand (289,136 tons), and the indicated demand of 367,070 tons a month in 1938 was 123 percent of the expected demand (297,864 tons).

The demand for asphalt is seasonal to a marked degree, reaching its maximum in August and its minimum in February. Normally, 65 percent of the indicated consumption of asphalt occurs in the 6 months from May 1 to October 1; from 1936 to 1938, 69 percent of the annual total apparently was consumed in these months. Consequently, to furnish an adequate standard of comparison the monthly trend values are multiplied by a "seasonal factor" for each month.

In the first quarter of 1938 the indicated demand averaged 118 percent of the long-time trend multiplied by seasonal factors compared with 105 percent in the first 3 months of 1937. In the second quarter of 1938 it declined to 116 percent of the expected demand for these months compared with 119 percent during the second quarter of 1937. From July to September 1938 the demand was highest, averaging 133 percent of the expected demand compared with 132 percent in the same months of 1937. In the last quarter of 1938 the indicated demand averaged 122 percent of the expected demand compared with 99.7 percent in the last 3 months of 1937.

*Relation of indicated asphalt demand to basic trend multiplied by seasonal factors, 1937–38*

| Month | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Trend, multiplied by seasonal factors | Indicated monthly demand | Relation of indicated monthly demand to trend | Trend, multiplied by seasonal factors | Indicated monthly demand | Relation of indicated monthly demand to trend |
| | *Short tons* | *Short tons* | *Percent* | *Short tons* | *Short tons* | *Percent* |
| January | 169,202 | 150,772 | 89.1 | 174,310 | 229,001 | 131.4 |
| February | 155,295 | 176,207 | 113.5 | 159,983 | 153,342 | 95.9 |
| March | 199,128 | 222,806 | 111.9 | 205,139 | 254,351 | 124.0 |
| April | 273,002 | 281,437 | 103.1 | 281,243 | 297,329 | 105.7 |
| May | 335,860 | 406,235 | 121.0 | 345,999 | 398,654 | 115.2 |
| June | 373,940 | 479,223 | 128.2 | 385,228 | 475,112 | 123.3 |
| July | 384,754 | 498,228 | 129.5 | 396,368 | 478,289 | 120.7 |
| August | 399,789 | 501,023 | 125.3 | 411,856 | 581,820 | 141.2 |
| September | 384,348 | 541,176 | 140.8 | 395,950 | 541,739 | 136.8 |
| October | 376,368 | 399,829 | 106.2 | 387,730 | 489,368 | 126.2 |
| November | 240,821 | 263,247 | 109.3 | 248,091 | 310,373 | 125.1 |
| December | 177,125 | 129,120 | 72.9 | 182,471 | 195,468 | 107.1 |
| | 3,469,632 | 4,049,303 | 116.7 | 3,574,368 | 4,404,846 | 123.2 |

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## DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States decreased from 4,337,548 short tons in 1937 to 4,295,232 in 1938, according to freight-commodity statistics compiled by the Interstate Commerce Commission. The principal decreases occurred east of the Mississippi River and Lake Michigan and north of the Ohio and Potomac Rivers; in general, more asphalt was terminated by class I railroads west of the Mississippi River and south of the Ohio and Potomac Rivers in 1938 than in 1937.

Forty-nine percent of the asphalt (petroleum, lake, and natural-rock) terminated in the continental United States by land carriers and intraport vessels was delivered to consumers in the Northeastern district, lying north of the Potomac and Ohio Rivers and east of the Mississippi and Illinois Rivers. Railroads and minor carriers terminated 2,400,706 short tons of asphalt in this district in 1937 and 2,418,722 tons in 1938. In the Southeastern district, lying south of the Potomac and Ohio Rivers and east of the Mississippi and Pearl Rivers, land deliveries of asphalt increased from 531,230 tons in 1937 to 663,802 tons in 1938. In the Southwestern district, lying west of the Mississippi and Pearl Rivers and south of St. Louis, Kansas City, and Amarillo, asphalt deliveries by rail and truck increased from 339,443 tons in 1937 to 372,610 tons in 1938. In the North Central district, lying between the Great Lakes and the Rocky Mountain front, 632,554 tons were delivered in 1937 and 677,478 tons in 1938. In the Pacific-Rocky Mountain district, lying west of Great Falls, Cheyenne, Denver, Albuquerque, and El Paso, the tonnage of asphalt terminated increased from 612,230 tons in 1937 to 768,773 in 1938.

*Supply and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, in continental United States in 1938, by districts, in short tons*

| | Northeastern district | Southeastern district | Southwestern district | North Central district | Pacific-Rocky Mountain district |
|---|---|---|---|---|---|
| Produced within district | 1,916,617 | 597,854 | 1,401,801 | | 1,102,751 |
| Imported | 26,087 | 3,929 | 3,275 | 41 | 30 |
| Received by rail from— | | | | | |
| Northeastern district | | 40,000 | 5,000 | 302,896 | |
| Southeastern district | 329,372 | | | | |
| Southwestern district | 165,000 | 259,682 | | 325,438 | 58,000 |
| Pacific-Rocky Mountain district | 28,000 | | 24,545 | 50,000 | |
| Net receipts by water | 283,075 | 89,482 | 8,017 | | |
| Withdrawn from stocks | 62,097 | 3,462 | 31,154 | | |
| | 2,810,248 | 994,409 | 1,473,792 | 678,375 | 1,160,781 |
| Shipped by rail— | | | | | |
| Within district | 2,210,284 | 582,581 | 275,316 | 677,478 | 549,573 |
| To Northeastern district | | 329,372 | 165,000 | | 28,000 |
| To Southeastern district | 40,000 | | 259,682 | | |
| To Southwestern district | 5,000 | | | | 24,545 |
| To North Central district | 302,896 | | 325,438 | | 50,000 |
| To Pacific-Rocky Mountain district | | | 58,000 | | |
| Shipped by motortruck, minor railroads, and intraport | 208,438 | 81,221 | 97,294 | | 219,200 |
| Net shipments by water | | | 220,752 | | 159,822 |
| Exported | 43,630 | 1,235 | 72,310 | 897 | 99,966 |
| Added to stocks | | | | | 29,675 |
| | 2,810,248 | 994,409 | 1,473,792 | 678,375 | 1,160,781 |

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## FOREIGN TRADE

*Imports.*—Imports of natural asphalt and bitumen into the United States declined from 28,663 short tons valued at $395,882 in 1937 to 23,645 valued at $378,209 in 1938. Imports of lake asphalt from Trinidad decreased from 24,790 tons valued at $239,697 in 1937 to 19,396 valued at $205,038 in 1938. On the other hand, imports of grahamite from Cuba rose from 3,162 tons valued at $52,024 in 1937 to 3,826 valued at $65,344 in 1938.

Atlantic coast ports (chiefly New York) received 16,320 tons of natural asphalt and bitumen and Gulf coast ports (Mobile, New Orleans, and Galveston) 7,204 tons in 1938.

Imports of petroleum asphalt, including cut-backs, and road oil decreased from 344,960 barrels (62,720 short tons) valued at $260,132 in 1937 to 53,822 barrels (9,786 tons) valued at $38,883 in 1938. Of the 1938 imports, 53,449 barrels received in the customs district of Philadelphia came from Mexico and 373 barrels received in the customs district of Puerto Rico came from the Netherlands.

*Exports.*—Resuming the downward trend manifested since 1928, exports of petroleum asphalt were 3 percent smaller in 1938 than in 1937. Although foreign sales of unmanufactured petroleum asphalt increased from 41,299 short tons valued at $657,894 in 1937 to 42,290 valued at $734,683 in 1938, sales of manufactures of petroleum asphalt to other countries decreased from 167,458 tons valued at $2,453,233 in 1937 to 160,209 valued at $2,295,479 in 1938. As most of these manufactures were simply processed forms of asphalt, the exports of manufactured and unmanufactured asphalt in 1937 and 1938 have been combined in the following table for comparison with the 1936 exports that were not so differentiated.

The principal decreases were in sales to eastern and southern Asia, especially China, Japan, British Malaya, British India, and Ceylon. On the other hand, more asphalt was sold to Australia, New Zealand, and French Indochina. Less asphalt was shipped from the United States to the Union of South Africa and Mozambique in 1938 than in 1937. However, the decreases in exports of asphalt to eastern Asia and the Indian Ocean region were partly compensated by increases in sales to other countries of North America, to South America, and to the United Kingdom.

*Petroleum asphalt exported from the United States, 1936–38, by countries*

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| North America: | | | | | | |
| Canada | 3,695 | $75,171 | 5,264 | $105,585 | 11,565 | $120,589 |
| Other North America | 5,803 | 86,475 | 6,076 | 96,119 | 12,015 | 202,144 |
| | 9,498 | 161,646 | 11,340 | 201,704 | 23,580 | 322,733 |
| South America: | | | | | | |
| Argentina | 226 | 5,246 | 268 | 6,361 | 451 | 9,400 |
| Brazil | 5,823 | 76,686 | 8,210 | 105,367 | 8,459 | 123,633 |
| Other South America | 2,136 | 30,256 | 2,209 | 35,820 | 6,951 | 131,892 |
| | 8,185 | 112,188 | 10,687 | 147,548 | 15,861 | 264,925 |

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*Petroleum asphalt exported from the United States, 1936–38, by countries*—Cont.

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Europe: | | | | | | |
| Belgium | 2,697 | $37,246 | 1,751 | $24,018 | 2,924 | $38,928 |
| Denmark | 26 | 1,157 | 75 | 1,762 | 118 | 3,867 |
| France | 4,556 | 71,014 | 4,461 | 68,441 | 4,010 | 52,187 |
| Germany | 682 | 17,078 | 603 | 14,347 | 354 | 8,832 |
| Italy | 27,830 | 395,017 | 3,559 | 52,808 | 32 | 661 |
| Netherlands | 1,049 | 14,872 | 1,121 | 17,585 | 578 | 8,331 |
| Spain | 337 | 6,309 | | | 56 | 2,714 |
| United Kingdom | 20,829 | 399,820 | 21,156 | 364,277 | 29,222 | 455,126 |
| Other Europe | 4,227 | 70,041 | 3,355 | 61,574 | 3,746 | 66,492 |
| | 62,233 | 1,012,554 | 36,081 | 604,812 | 41,040 | 637,138 |
| Asia: | | | | | | |
| British Malaya | 8,791 | 134,276 | 16,776 | 221,882 | 9,508 | 174,017 |
| Ceylon | 2,295 | 27,528 | 6,593 | 86,264 | 3,453 | 49,504 |
| China | 7,348 | 100,724 | 7,956 | 123,054 | 2,153 | 31,699 |
| Hong Kong | 2,014 | 30,644 | 3,244 | 46,030 | 2,642 | 38,788 |
| India, British | 13,894 | 192,920 | 24,736 | 353,923 | 10,427 | 149,979 |
| Indochina | 8,458 | 107,588 | 5,621 | 54,989 | 5,809 | 85,590 |
| Japan | 3,858 | 51,591 | 4,908 | 75,983 | 1,964 | 30,172 |
| Netherland India | 17,903 | 238,506 | 17,323 | 238,965 | 13,022 | 190,183 |
| Philippine Islands | 10,695 | 122,226 | 11,627 | 143,973 | 11,367 | 150,427 |
| Other Asia | 861 | 13,549 | 169 | 4,661 | 2,493 | 42,878 |
| | 76,117 | 1,019,552 | 98,953 | 1,349,724 | 62,838 | 943,237 |
| Africa: | | | | | | |
| Mozambique | 8,758 | 151,712 | 6,985 | 124,046 | 5,391 | 96,465 |
| Tunisia | 59 | 1,060 | 19 | 437 | | |
| Union of South Africa | 12,964 | 198,950 | 16,079 | 279,249 | 11,567 | 195,501 |
| Other Africa | 833 | 13,987 | 400 | 7,457 | 1,700 | 30,420 |
| | 22,614 | 365,709 | 23,483 | 411,189 | 18,658 | 322,386 |
| Oceania: | | | | | | |
| Australia | 6,536 | 92,608 | 21,977 | 299,079 | 32,510 | 436,460 |
| New Zealand | 4,582 | 59,018 | 6,105 | 95,209 | 7,787 | 100,199 |
| Other Oceania | 738 | 11,898 | 131 | 1,862 | 225 | 3,084 |
| | 11,856 | 163,524 | 28,213 | 396,150 | 40,522 | 539,743 |
| | 190,503 | 2,835,173 | 208,757 | 3,111,127 | 202,499 | 3,030,162 |

## ROAD OIL

Decreased construction of oil-treated macadam, gravel, and sand-clay highways resulted in a decline of 9 percent in refinery sales of road oil—from 8,733,650 barrels in 1937 to 7,904,890 in 1938. As a result of lower prices, the value at the refineries of sales of road oil decreased 20 percent—from $12,183,213 in 1937 to $9,704,689 in 1938.

The declines were greatest in the following districts: California, Arkansas and Louisiana Inland; Indiana, Illinois, Kentucky, etc.; Rocky Mountain; and East Coast. Gains in the Oklahoma, Kansas, and Missouri district, the Appalachian district, and the Louisiana Gulf Coast district were insufficient to offset the general decline.

Of the road oil sold in 1938 only 632,423 barrels valued at $1,080,699 were made from foreign petroleum, imported chiefly from Venezuela and Mexico. Of the road oil made from foreign crude, 77 percent was sold by refineries of the Atlantic Coast district in 1937 and 76 percent in 1938; the remainder was sold by Gulf Coast refineries of Louisiana and Texas.

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*Road oil sold by petroleum refineries in the United States, 1937–38, by districts*

| District | 1937 | | 1938 | |
|---|---|---|---|---|
| | Barrels | Value | Barrels | Value |
| East Coast | 1,041,454 | $1,718,132 | 943,073 | $1,544,169 |
| Appalachian | 43,135 | 91,308 | 146,066 | 185,542 |
| Indiana, Illinois, Kentucky, etc | 1,876,768 | 2,753,226 | 1,751,411 | 2,390,213 |
| Oklahoma, Kansas, and Missouri | 707,032 | 835,275 | 919,151 | 841,264 |
| Texas: | | | | |
| Gulf Coast | 289,861 | 486,350 | 239,555 | 360,295 |
| Inland | 2,843 | 3,432 | 2,139 | 2,713 |
| Total, Texas | 292,704 | 489,782 | 241,694 | 363,008 |
| Louisiana-Arkansas: | | | | |
| Louisiana Gulf Coast | 133,922 | 182,502 | 176,476 | 264,355 |
| Arkansas and Louisiana Inland | 395,171 | 457,024 | 129,828 | 170,048 |
| Total, Louisiana-Arkansas | 529,093 | 639,526 | 306,304 | 434,403 |
| Rocky Mountain | 1,245,266 | 2,494,609 | 1,183,880 | 1,492,280 |
| California | 2,998,198 | 3,161,355 | 2,413,311 | 2,453,810 |
| Grand total | 8,733,650 | 12,183,213 | 7,904,890 | 9,704,689 |

Petroleum refineries in the United States reported the production of 7,542,755 barrels of road oil in 1938 compared with 8,087,231 in 1937. The refinery output of road oil in 1938 was augmented by 722,100 barrels of other petroleum products, chiefly fuel oil, transferred to road-oil stocks compared with 1,089,167 barrels similarly transferred in 1937. Stocks of road oil and transferred oils held at refineries decreased 44,296 barrels during 1938, whereas they increased 127,804 barrels during 1937. Consumption of road oil at refineries in operations, transfers, losses, and adjustments were 404,261 barrels in 1938 compared with 314,944 in 1937.

The average value of road oil sold in the United States f. o. b. refinery fell from $1.39 in 1937 to $1.23 in 1938. The principal decreases were in the Appalachian district (from $2.12 per barrel in 1937 to $1.27 in 1938), in the Rocky Mountain district (from $2.00 to $1.26), in the Oklahoma, Kansas, and Missouri district (from $1.18 to $0.92), in the Indiana, Illinois, Kentucky, etc., district (from $1.47 to $1.36), and in the Texas Gulf Coast district (from $1.68 to $1.50). Gains in Inland Texas (from $1.21 to $1.27), in the Gulf Coast of Louisiana (from $1.36 to $1.50), and in Arkansas and Louisiana Inland ($1.16 to $1.31) were insufficient to check the general decline.

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# CEMENT

By Oliver Bowles and E. V. Balser

## SUMMARY OUTLINE


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Production of portland cement in the United States in 1938 declined to 105,357,000 barrels and shipments to 106,324,127 barrels valued at $153,977,226, according to final annual reports submitted by cement companies to the Bureau of Mines. The preliminary figures on production and shipments for 1938, published by the Bureau of Mines in January 1939, were each 0.2 percent greater than the final figures. The final figures represent a decline of 9 percent in production, 7 percent in shipments, and 9 percent in mill value of shipments compared with 1937. For the first 5 months of 1938 shipments were 13 percent lower than for the same period of 1937. Thereafter the decline from the corresponding months of 1937 was smaller, but not until October did shipments in 1938 exceed those in 1937.

The Federal Reserve Board annual index for cement production in 1938 was 71 compared with 65 for the durable-goods industries and 64 for the construction industries. Corresponding figures for 1937 were cement 78, durable-goods industries 109, and construction industries 59.

The average factory value was $1.45 a barrel in 1938 compared with $1.48 a barrel in 1937.

Shipments included 3,385,523 barrels of high-early-strength portland cement valued at $6,247,699, an average of $1.85 a barrel, in 1938 compared with 3,845,314 barrels valued at $7,134,468, an average of $1.86 a barrel, in 1937.

The quantity of natural, masonry (natural), and puzzolan cements produced decreased 10 percent and shipments 7 percent compared with 1937. The value of shipments of these varieties declined 1 percent.

The following tables present the outstanding features of the cement industry during recent years.



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*Salient statistics of the cement industry in the United States, 1935–38*

| | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| Domestic production: | | | | |
| Portland ..... barrels | 76,741,570 | 112,649,782 | 116,174,708 | 105,357,000 |
| Masonry, natural, and puzzolan (slag-lime) barrels | 1,006,064 | 1,819,488 | 1,900,643 | 1,704,662 |
| Total production ..... do | 77,747,634 | 114,469,270 | 118,075,351 | 107,061,662 |
| Active plants: | | | | |
| Portland ..... number | 150 | 149 | 150 | 151 |
| Masonry, natural, and puzzolan (slag-lime) number | 13 | 13 | 12 | 11 |
| Domestic shipments: | | | | |
| Portland ..... barrels | 75,232,917 | 112,849,979 | 113,804,782 | 106,324,127 |
| Value ..... | $113,372,182 | $170,415,302 | $168,835,208 | $153,977,226 |
| Masonry, natural, and puzzolan (slag-lime) barrels | 1,011,411 | 1,760,993 | 1,873,400 | 1,745,541 |
| Value ..... | $1,437,542 | $2,362,396 | $2,578,885 | $2,558,077 |
| Total shipments ..... barrels | 76,244,328 | 114,610,972 | 115,678,182 | 108,069,668 |
| Value ..... | $114,809,724 | $172,777,698 | $171,414,093 | $156,535,303 |
| Imports ..... barrels | 619,404 | 1,658,902 | 1,803,932 | 1,727,411 |
| Exports ..... do | 416,099 | 334,673 | 378,554 | 558,226 |
| Apparent consumption ..... do | 76,447,633 | 115,935,201 | 117,103,560 | 109,238,853 |
| Stocks at mills at end of year: | | | | |
| Portland: | | | | |
| Finished cement ..... do | 23,064,563 | 22,568,685 | 24,938,612 | 23,946,118 |
| Clinker ..... do | 5,226,000 | 5,564,000 | 6,342,000 | 5,282,000 |
| Masonry, natural, and puzzolan (slag-lime) barrels | 172,572 | 230,788 | 258,031 | 196,649 |

*Principal hydraulic cements produced and shipped in the United States, 1933–38*

| Year | Active plants | Production | | | | |
|---|---|---|---|---|---|---|
| | | Portland cement (barrels) | Masonry, natural, and puzzolan (slag-lime) cements | | Total | |
| | | | Active plants | Barrels | Active plants | Barrels |
| 1933 | 152 | 63,473,189 | 13 | 511,201 | 165 | 63,984,390 |
| 1934 | 150 | 77,747,765 | 14 | 671,588 | 164 | 78,419,353 |
| 1935 | 150 | 76,741,570 | 13 | 1,006,064 | 163 | 77,747,634 |
| 1936 | 149 | 112,649,782 | 13 | 1,819,488 | 162 | 114,469,270 |
| 1937 | 150 | 116,174,708 | 12 | 1,900,643 | 162 | 118,075,351 |
| 1938 | 151 | 105,357,000 | 11 | 1,704,662 | 162 | 107,061,662 |

| Year | Shipments | | | | | |
|---|---|---|---|---|---|---|
| | Portland cement | | Masonry, natural, and puzzolan (slag-lime) cements | | Total | |
| | Barrels | Value | Barrels | Value | Barrels | Value |
| 1933 | 64,282,756 | [1] $85,583,916 | 477,761 | $644,750 | 64,760,517 | [1] $86,228,666 |
| 1934 | 75,901,279 | 116,921,084 | 678,204 | 960,732 | 76,579,483 | 117,881,816 |
| 1935 | 75,232,917 | 113,372,182 | 1,011,411 | 1,437,542 | 76,244,328 | 114,809,724 |
| 1936 | 112,849,979 | 170,415,302 | 1,760,993 | 2,362,396 | 114,610,972 | 172,777,698 |
| 1937 | 113,804,782 | 168,835,208 | 1,873,400 | 2,578,885 | 115,678,182 | 171,414,093 |
| 1938 | 106,324,127 | 153,977,226 | 1,745,541 | 2,558,077 | 108,069,668 | 156,535,303 |

[1] Corrected figures.

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## PORTLAND CEMENT

### PRODUCTION, SHIPMENTS, AND STOCKS

Portland cement is the product that is obtained by pulverizing to a fine consistency a clinker produced by calcining to incipient fusion an intimate mixture of properly proportioned argillaceous and calcareous substances, with only such additions subsequent to calcining as may be necessary to control setting and certain other properties. Such additions, which usually comprise about 3 to 3½ percent by weight of the calcined product, consist principally of gypsum or mixtures of gypsum and anhydrite. The principal combinations of raw materials are (1) limestone with clay or shale, (2) cement rock (argillaceous limestone) either alone or with high-calcium limestone, (3) blast-furnace slag and limestone, (4) marl and clay, and (5) oyster shells and clay.

Some years ago all portland cement had fairly constant and uniform properties; in other words, there was only one standard portland cement. In recent years the varied demands of construction have led to the development of a variety of portland cements each adapted to a particular use. These include high-early-strength, masonry, low-heat, and oil-well cements. Statistics for all varieties are given in the general tables covering portland cement, and the special types are discussed in more detail, with statistics wherever available, in a later section of this report. The special portland cements are to be distinguished from certain other types, such as natural and slag-lime cements, which are quite distinct from portland cement and are covered in a separate section of this chapter.

The following tables present the principal statistics of portland cement. In the first table, relating to production, shipments, and stocks by States and districts, the term "active plant" is applied to a mill or group of mills situated at one place and operated by one company. If a company has establishments at different places, its mill or group of mills at each place is counted as a plant. The districts are groups of States related geographically and commercially.

The tables giving data by months, compiled from monthly reports of the producers, include figures of clinker or unground cement produced and in reserve at the mills awaiting manufacture into finished cement. Although the figures may differ slightly from those based on annual reports of the producers, they reflect accurately the seasonal fluctuations in the industry.

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*Portland cement produced, shipped, and in stock in the United States, 1937–38, by States and districts*

| | Active plants | | Production | | | Shipments | | | | | | | Stock at mills (Dec. 31) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Barrels | | Increase or decrease, 1938 (percent) | 1937 | | 1938 | | Average factory value per barrel | | Increase or decrease in quantity, 1938 (percent) | Barrels | | Increase or decrease, 1938 (percent) |
| | 1937 | 1938 | 1937 | 1938 | | Barrels | Value | Barrels | Value | 1937 | 1938 | | 1937 | 1938 | |
| STATE | | | | | | | | | | | | | | | |
| Alabama | 5 | 6 | 4,415,141 | 4,627,639 | +5 | 4,403,459 | $6,165,974 | 4,548,079 | $6,114,246 | $1.40 | $1.34 | +3 | 595,959 | 675,520 | +13 |
| California | 10 | 10 | 11,953,986 | 10,513,067 | −12 | 11,877,642 | 17,900,739 | 10,539,010 | 15,689,210 | 1.51 | 1.49 | −11 | 1,506,557 | 1,475,460 | −2 |
| Illinois | 4 | 4 | 5,246,102 | 3,959,932 | −25 | 4,713,734 | 6,756,747 | 4,357,119 | 5,993,644 | 1.43 | 1.38 | −8 | 1,230,203 | 833,017 | −32 |
| Iowa | 5 | 5 | 4,706,094 | 4,726,517 | +.4 | 4,598,453 | 7,046,021 | 4,759,390 | 7,327,048 | 1.53 | 1.54 | +3 | 1,569,787 | 1,536,914 | −2 |
| Kansas | 6 | 6 | 3,696,507 | 3,264,350 | −12 | 3,500,684 | 5,482,851 | 3,217,497 | 4,949,018 | 1.57 | 1.54 | −8 | 1,034,619 | 1,081,375 | +5 |
| Michigan | 11 | 11 | 8,180,969 | 7,159,362 | −12 | 7,831,880 | 9,836,999 | 7,192,511 | 8,767,859 | 1.26 | 1.22 | −8 | 2,110,936 | 2,077,781 | −2 |
| Missouri | 5 | 5 | 4,756,285 | 4,491,458 | −6 | 4,565,448 | 7,041,016 | 4,570,389 | 6,871,120 | 1.54 | 1.50 | +.1 | 1,055,803 | 976,873 | −7 |
| New York | 10 | 10 | 5,912,772 | 5,807,731 | −2 | 6,106,083 | 8,825,785 | 5,720,922 | 7,893,270 | 1.45 | 1.38 | −6 | 1,517,879 | 1,598,184 | +5 |
| Ohio | 9 | 9 | 5,699,695 | 5,188,477 | −9 | 5,501,769 | 7,771,268 | 5,258,603 | 7,094,745 | 1.41 | 1.35 | −4 | 1,749,136 | 1,665,540 | −5 |
| Pennsylvania | 26 | 25 | 23,064,465 | 20,868,384 | −10 | 22,952,603 | 31,917,831 | 21,082,966 | 28,242,913 | 1.39 | 1.34 | −8 | 5,627,030 | 5,412,451 | −4 |
| Tennessee | 6 | 6 | 3,081,215 | 3,318,797 | +8 | 3,013,817 | 4,683,717 | 3,390,871 | 5,063,628 | 1.55 | 1.49 | +13 | 605,448 | 533,387 | −12 |
| Texas | 9 | 10 | 6,906,453 | 6,949,164 | +.6 | 6,687,719 | 11,488,866 | 7,116,545 | 11,885,494 | 1.72 | 1.67 | +6 | 947,384 | 780,502 | −18 |
| Other States [1] | 44 | 44 | 28,555,024 | 24,482,122 | −14 | 28,051,491 | 43,917,394 | 24,570,225 | 38,085,031 | 1.57 | 1.55 | −12 | 5,387,371 | 5,299,114 | −2 |
| | 150 | 151 | 116,174,708 | 105,357,000 | −9 | 113,804,782 | 168,835,208 | 106,324,127 | 153,977,226 | 1.48 | 1.45 | −7 | 24,938,612 | 23,946,118 | −4 |
| DISTRICT | | | | | | | | | | | | | | | |
| Eastern Pennsylvania, New Jersey, and Maryland | 23 | 22 | 21,195,678 | 19,895,691 | −6 | 21,208,823 | 29,218,161 | 19,825,160 | 26,222,912 | 1.38 | 1.32 | −7 | 4,513,213 | 4,583,747 | +2 |
| New York and Maine | 11 | 11 | 6,370,647 | 6,245,193 | −2 | 6,528,262 | 9,523,312 | 6,184,521 | 8,631,618 | 1.46 | 1.40 | −5 | 1,653,706 | 1,707,874 | +3 |
| Ohio, western Pennsylvania, and West Virginia | 18 | 18 | 10,787,616 | 9,374,184 | −13 | 10,579,782 | 15,054,581 | 9,632,020 | 13,073,949 | 1.42 | 1.36 | −9 | 3,404,459 | 3,133,153 | −8 |
| Michigan | 11 | 11 | 8,180,969 | 7,159,362 | −12 | 7,831,880 | 9,836,999 | 7,192,511 | 8,767,859 | 1.26 | 1.22 | −8 | 2,110,936 | 2,077,781 | −2 |
| Wisconsin, Illinois, Indiana, and Kentucky | 11 | 11 | 12,748,994 | 9,930,734 | −22 | 11,723,854 | 17,419,152 | 10,760,293 | 15,454,526 | 1.49 | 1.44 | −8 | 2,937,506 | 2,107,791 | −28 |
| Virgina, Tennessee, Alabama, Georgia, Florida, and Louisiana | 17 | 18 | 11,017,080 | 12,026,249 | +9 | 11,084,366 | 16,405,721 | 12,020,082 | 17,326,540 | 1.48 | 1.44 | +8 | 1,806,111 | 1,812,294 | +.3 |
| Eastern Missouri, Iowa, Minnesota, and South Dakota | 11 | 11 | 10,675,595 | 9,994,563 | −6 | 10,294,618 | 15,788,687 | 10,190,025 | 15,572,640 | 1.53 | 1.53 | −1 | 2,942,357 | 2,746,895 | −7 |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas | 12 | 12 | 8,651,217 | 7,602,704 | −12 | 8,342,027 | 12,932,031 | 7,442,529 | 11,304,784 | 1.55 | 1.52 | −11 | 1,942,457 | 2,102,536 | +8 |
| Texas | 9 | 10 | 6,906,453 | 6,949,164 | +.6 | 6,687,719 | 11,488,866 | 7,116,545 | 11,885,494 | 1.72 | 1.67 | +6 | 947,884 | 780,502 | −18 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 8 | 8 | 3,056,597 | 2,689,465 | −12 | 3,000,825 | 5,929,894 | 2,705,161 | 5,365,567 | 1.98 | 1.98 | −10 | 625,369 | 609,674 | −3 |
| California | 10 | 10 | 11,953,986 | 10,513,067 | −12 | 11,877,642 | 17,900,739 | 10,539,010 | 15,689,210 | 1.51 | 1.49 | −11 | 1,506,557 | 1,475,460 | −2 |
| Oregon and Washington | 9 | 9 | 4,629,876 | 2,976,624 | −36 | 4,644,984 | 7,337,065 | 2,716,270 | 4,682,127 | 1.58 | 1.72 | −42 | 548,057 | 808,411 | +48 |
| | 150 | 151 | 116,174,708 | 105,357,000 | −9 | 113,804,782 | 168,835,208 | 106,324,127 | 153,977,226 | 1.48 | 1.45 | −7 | 24,938,612 | 23,946,118 | −4 |

[1] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.



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*Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1938, by districts, in thousands of barrels*

| District | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCTION | | | | | | | | | | | | |
| Eastern Pennsylvania, New Jersey, and Maryland | 475 | 488 | 1,227 | 1,935 | 2,231 | 2,245 | 2,013 | 2,273 | 1,919 | 2,170 | 1,738 | 1,192 |
| New York and Maine | 122 | 106 | 257 | 557 | 716 | 816 | 810 | 674 | 561 | 777 | 525 | 324 |
| Ohio, western Pennsylvania, and West Virginia | 261 | 175 | 460 | 667 | 865 | 959 | 1,132 | 1,246 | 1,119 | 1,197 | 799 | 536 |
| Michigan | 308 | 266 | 277 | 399 | 736 | 834 | 827 | 704 | 753 | 825 | 751 | 559 |
| Wisconsin, Illinois, Indiana, and Kentucky | 637 | 383 | 503 | 439 | 644 | 838 | 1,224 | 1,177 | 1,051 | 1,150 | 1,065 | 839 |
| Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana | 653 | 635 | 831 | 955 | 1,020 | 985 | 1,219 | 1,186 | 1,004 | 1,216 | 1,181 | 1,136 |
| Eastern Missouri, Iowa, Minnesota, and South Dakota | 362 | 171 | 373 | 625 | 1,009 | 1,030 | 1,114 | 1,179 | 1,142 | 1,182 | 1,097 | 734 |
| Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas | 567 | 400 | 449 | 535 | 824 | 671 | 518 | 571 | 811 | 836 | 745 | 687 |
| Texas | 334 | 444 | 664 | 751 | 717 | 611 | 630 | 390 | 624 | 536 | 648 | 605 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 85 | 88 | 117 | 194 | 279 | 344 | 274 | 284 | 259 | 327 | 276 | 163 |
| California | 695 | 675 | 658 | 795 | 1,048 | 955 | 958 | 951 | 990 | 925 | 945 | 918 |
| Oregon and Washington | 35 | 85 | 63 | 131 | 272 | 247 | 249 | 372 | 326 | 415 | 414 | 373 |
| United States, 1938 | 4,534 | 3,916 | 5,879 | 7,983 | 10,361 | 10,535 | 10,968 | 11,007 | 10,559 | 11,556 | 10,184 | 8,066 |
| 1937 | 6,616 | 5,837 | 8,443 | 10,402 | 11,634 | 11,163 | 11,597 | 11,894 | 11,223 | 11,374 | 9,248 | 7,047 |
| SHIPMENTS | | | | | | | | | | | | |
| Eastern Pennsylvania, New Jersey, and Maryland | 669 | 835 | 1,431 | 1,842 | 2,059 | 2,115 | 2,036 | 2,081 | 2,038 | 2,053 | 1,564 | 1,125 |
| New York and Maine | 152 | 174 | 355 | 490 | 654 | 732 | 724 | 711 | 713 | 674 | 475 | 330 |
| Ohio, western Pennsylvania, and West Virginia | 361 | 380 | 636 | 802 | 873 | 1,012 | 1,028 | 1,196 | 1,031 | 1,184 | 700 | 428 |
| Michigan | 177 | 196 | 408 | 586 | 650 | 812 | 650 | 902 | 958 | 983 | 636 | 347 |
| Wisconsin, Illinois, Indiana, and Kentucky | 257 | 297 | 606 | 796 | 845 | 1,091 | 1,149 | 1,497 | 1,416 | 1,531 | 805 | 470 |
| Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana | 648 | 717 | 901 | 935 | 1,058 | 1,099 | 991 | 1,223 | 1,194 | 1,273 | 1,027 | 956 |
| Eastern Missouri, Iowa, Minnesota, and South Dakota | 232 | 278 | 591 | 730 | 974 | 1,254 | 1,141 | 1,211 | 1,343 | 1,415 | 653 | 385 |
| Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas | 396 | 354 | 628 | 618 | 618 | 676 | 648 | 810 | 826 | 846 | 585 | 449 |
| Texas | 530 | 532 | 646 | 580 | 612 | 664 | 507 | 579 | 601 | 650 | 636 | 584 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 94 | 125 | 193 | 246 | 270 | 300 | 258 | 294 | 305 | 304 | 181 | 134 |
| California | 801 | 604 | 746 | 891 | 974 | 1,024 | 839 | 1,075 | 965 | 1,001 | 887 | 773 |
| Oregon and Washington | 73 | 83 | 118 | 175 | 165 | 164 | 193 | 244 | 326 | 443 | 424 | 309 |
| United States, 1938 | 4,390 | 4,575 | 7,259 | 8,691 | 9,752 | 10,943 | 10,164 | 11,823 | 11,716 | 12,357 | 8,573 | 6,290 |
| 1937 | 4,689 | 5,163 | 7,879 | 10,272 | 11,890 | 12,645 | 12,237 | 12,291 | 12,773 | 11,190 | 8,188 | 4,793 |

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| STOCKS (END OF MONTH) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eastern Pennsylvania, New Jersey, and Maryland | 4,321 | 3,974 | 3,771 | 3,864 | 4,036 | 4,166 | 4,143 | 4,336 | 4,217 | 4,334 | 4,508 | 4,577 |
| New York and Maine | 1,617 | 1,550 | 1,451 | 1,519 | 1,581 | 1,665 | 1,751 | 1,713 | 1,561 | 1,664 | 1,715 | 1,710 |
| Ohio, western Pennsylvania, and West Virginia | 3,294 | 3,089 | 2,912 | 2,773 | 2,763 | 2,710 | 2,814 | 2,862 | 2,947 | 2,959 | 3,058 | 3,141 |
| Michigan | 2,265 | 2,334 | 2,203 | 2,015 | 2,102 | 2,124 | 2,302 | 2,104 | 1,899 | 1,736 | 1,850 | 2,078 |
| Wisconsin, Illinois, Indiana, and Kentucky | 3,275 | 3,361 | 3,258 | 2,900 | 2,699 | 2,446 | 2,536 | 2,215 | 1,850 | 1,469 | 1,730 | 2,098 |
| Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana | 1,812 | 1,730 | 1,660 | 1,680 | 1,642 | 1,530 | 1,758 | 1,721 | 1,532 | 1,476 | 1,630 | 1,810 |
| Eastern Missouri, Iowa, Minnesota, and South Dakota | 3,073 | 2,966 | 2,747 | 2,642 | 2,676 | 2,452 | 2,425 | 2,393 | 2,192 | 1,959 | 2,404 | 2,753 |
| Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas | 2,126 | 2,169 | 1,990 | 1,907 | 2,113 | 2,108 | 1,978 | 1,738 | 1,723 | 1,711 | 1,871 | 2,112 |
| Texas | 752 | 664 | 681 | 853 | 958 | 905 | 1,027 | 838 | 862 | 748 | 759 | 780 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 616 | 578 | 503 | 451 | 460 | 503 | 519 | 510 | 463 | 487 | 581 | 612 |
| California | 1,365 | 1,436 | 1,348 | 1,253 | 1,327 | 1,257 | 1,376 | 1,319 | 1,343 | 1,268 | 1,325 | 1,470 |
| Oregon and Washington | 507 | 510 | 455 | 405 | 518 | 601 | 657 | 785 | 785 | 758 | 748 | 813 |
| United States, 1938 | 25,023 | 24,361 | 22,979 | 22,262 | 22,875 | 22,467 | 23,286 | 22,534 | 21,374 | 20,569 | 22,179 | 23,954 |
| 1937 | 24,393 | 25,059 | 25,622 | 25,747 | 25,493 | 24,011 | 23,370 | 22,940 | 21,388 | 21,565 | 22,634 | 24,879 |

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*Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1938, by districts, in thousands of barrels*

| District | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCTION | | | | | | | | | | | | |
| Eastern Pennsylvania, New Jersey, and Maryland | 517 | 498 | 1,202 | 1,825 | 2,194 | 2,157 | 2,015 | 2,328 | 1,803 | 2,094 | 1,732 | 1,285 |
| New York and Maine | 98 | 79 | 301 | 570 | 744 | 819 | 742 | 643 | 557 | 752 | 597 | 266 |
| Ohio, western Pennsylvania, and West Virginia | 292 | 237 | 526 | 630 | 931 | 973 | 1,108 | 1,169 | 1,117 | 1,157 | 785 | 470 |
| Michigan | 339 | 271 | 317 | 381 | 651 | 743 | 780 | 720 | 672 | 736 | 686 | 654 |
| Wisconsin, Illinois, Indiana, and Kentucky | 777 | 542 | 458 | 394 | 601 | 831 | 1,138 | 1,131 | 960 | 998 | 1,083 | 886 |
| Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana | 625 | 551 | 711 | 867 | 1,009 | 1,087 | 1,221 | 1,203 | 1,010 | 1,096 | 1,192 | 1,117 |
| Eastern Missouri, Iowa, Minnesota, and South Dakota | 408 | 270 | 375 | 702 | 971 | 1,029 | 1,136 | 1,122 | 1,079 | 1,098 | 1,091 | 712 |
| Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas | 552 | 410 | 364 | 573 | 832 | 680 | 490 | 508 | 773 | 806 | 768 | 675 |
| Texas | 263 | 415 | 643 | 775 | 747 | 491 | 743 | 419 | 498 | 502 | 613 | 692 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 75 | 94 | 109 | 213 | 317 | 333 | 249 | 260 | 271 | 322 | 228 | 188 |
| California | 789 | 695 | 613 | 690 | 850 | 1,001 | 948 | 976 | 979 | 934 | 999 | 992 |
| Oregon and Washington | 27 | (1) | 68 | 201 | 217 | 217 | 270 | 431 | 408 | 422 | 429 | 426 |
| United States, 1938 | 4,762 | 4,062 | 5,687 | 7,821 | 10,064 | 10,361 | 10,840 | 10,910 | 10,127 | 10,917 | 10,203 | 8,363 |
| 1937 | 7,162 | 6,454 | 9,172 | 10,299 | 11,614 | 10,963 | 11,025 | 11,518 | 10,707 | 11,307 | 9,426 | 7,196 |
| STOCKS (END OF MONTH) | | | | | | | | | | | | |
| Eastern Pennsylvania, New Jersey, and Maryland | 919 | 938 | 935 | 834 | 813 | 781 | 767 | 832 | 725 | 665 | 670 | 777 |
| New York and Maine | 266 | 239 | 285 | 303 | 340 | 351 | 271 | 246 | 249 | 233 | 311 | 259 |
| Ohio, western Pennsylvania, and West Virginia | 671 | 734 | 799 | 753 | 835 | 845 | 832 | 759 | 753 | 716 | 700 | 635 |
| Michigan | 467 | 475 | 529 | 521 | 453 | 385 | 346 | 378 | 317 | 244 | 185 | 267 |
| Wisconsin, Illinois, Indiana, and Kentucky | 628 | 787 | 743 | 687 | 641 | 634 | 549 | 493 | 402 | 242 | 242 | 285 |
| Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana | 698 | 615 | 498 | 440 | 459 | 539 | 546 | 554 | 565 | 451 | 466 | 450 |
| Eastern Missouri, Iowa, Minnesota, and South Dakota | 405 | 492 | 499 | 577 | 548 | 558 | 578 | 535 | 481 | 406 | 409 | 381 |
| Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas | 472 | 481 | 392 | 424 | 434 | 448 | 417 | 354 | 309 | 283 | 308 | 301 |
| Texas | 255 | 232 | 228 | 269 | 307 | 192 | 310 | 341 | 224 | 190 | 161 | 255 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 109 | 116 | 107 | 128 | 168 | 159 | 135 | 111 | 124 | 120 | 74 | 116 |
| California | 1,310 | 1,319 | 1,298 | 1,174 | 1,000 | 1,022 | 1,012 | 908 | 879 | 885 | 923 | 984 |
| Oregon and Washington | 389 | 304 | 310 | 387 | 328 | 304 | 326 | 391 | 478 | 492 | 514 | 572 |
| United States, 1938 | 6,589 | 6,732 | 6,623 | 6,497 | 6,326 | 6,218 | 6,089 | 5,902 | 5,506 | 4,927 | 4,963 | 5,282 |
| 1937 | 6,160 | 6,788 | 7,554 | 7,544 | 7,540 | 7,360 | 6,771 | 6,347 | 5,896 | 5,859 | 6,104 | 6,342 |

[1] Less than 1,000 barrels.

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Producers' stocks of portland cement reported on hand at the mills were 4 percent lower at the end of 1938 than at the end of 1937. The following table gives stocks on December 31 and the seasonal fluctuations in stocks from 1934 to 1938.

*Producers' stocks of finished portland cement and clinker (unground cement) on hand at mills in the United States on Dec. 31 and monthly range, 1934–38*

| | | Dec. 31 (barrels) | Monthly range | | | |
|---|---|---|---|---|---|---|
| | | | Low | | High | |
| | | | Month | Barrels | Month | Barrels |
| 1934 | Cement | 21,440,594 | January | 19,547,000 | July | 21,852,000 |
| | Clinker | 6,166,000 | do | 5,919,000 | do | 6,588,000 |
| 1935 | Cement | 23,064,563 | October | 20,501,000 | do | 23,287,000 |
| | Clinker | 5,226,000 | December | 5,226,000 | do | 6,849,000 |
| 1936 | Cement | 22,568,685 | October | 18,079,000 | February | 22,971,000 |
| | Clinker | 5,564,000 | September | 4,838,000 | March | 5,625,000 |
| 1937 | Cement | 24,938,612 | do | 21,388,000 | April | 25,747,000 |
| | Clinker | 6,342,000 | October | 5,859,000 | March | 7,554,000 |
| 1938 | Cement | 23,946,118 | do | 20,569,000 | January | 25,023,000 |
| | Clinker | 5,282,000 | do | 4,927,000 | February | 6,732,000 |

## DOMESTIC CONSUMPTION

Apparent consumption (shipments plus imports minus exports) for a series of years is indicated in the table of salient statistics. The only available gage of consumption by States is the record of shipments into States by manufacturers; it is therefore merely approximate. Cement shipped to destinations within a State in which it is manufactured is of course added to that shipped from other States. Shipments into a State during any 1 year may not equal the consumption during that year but over a series of years should afford a fair index of consumption. The following table shows shipments into States in 1937 and 1938 and per capita consumption in each State.

The official figures for exports of cement differ from those reported by manufacturers in the following table, because cement forwarded from mills and destined to foreign countries and to Alaska, Hawaii, and Puerto Rico is reported by shippers as exported, whether or not it leaves the country during the calendar year, whereas the export figures of the Bureau of Foreign and Domestic Commerce record the cement that actually leaves the country during the period specified. The exports recorded by the Bureau of Foreign and Domestic Commerce include all hydraulic cement exported, whereas the figures supplied by producers relate to portland cement only.

The per capita consumption indicated in the table falls short of the total apparent consumption by the quantity of imports, which slightly affect certain States near the Canadian border and the seaboard.

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*Shipments of domestic portland cement from mills into States and per capita, 1937–38, in barrels* [1]

| State | 1937 | | 1938 | |
|---|---|---|---|---|
| | Total | Per capita [1] | Total | Per capita [1] |
| Alabama | 1,224,480 | 0.42 | 1,310,975 | 0.45 |
| Arizona [2] | 571,129 | 1.39 | 702,045 | 1.70 |
| Arkansas | 742,960 | .36 | 779,153 | .38 |
| California | 10,628,696 | 1.73 | 9,216,358 | 1.50 |
| Colorado | 1,056,286 | .99 | 856,634 | .80 |
| Connecticut [2] | 1,477,606 | .85 | 1,365,048 | .78 |
| Delaware [2] | 292,465 | 1.12 | 298,784 | 1.14 |
| District of Columbia [2] | 1,065,648 | 1.70 | 1,004,861 | 1.60 |
| Florida | 1,364,618 | .82 | 1,236,370 | .74 |
| Georgia | 1,422,525 | .46 | 1,323,885 | .43 |
| Idaho | 471,348 | .96 | 382,709 | .78 |
| Illinois | 6,945,077 | .88 | 6,432,231 | .82 |
| Indiana | 3,279,417 | .94 | 2,837,462 | .82 |
| Iowa | 3,248,502 | 1.27 | 3,226,718 | 1.26 |
| Kansas | 1,949,506 | 1.05 | 1,645,844 | .88 |
| Kentucky | 1,704,498 | .58 | 1,984,266 | .68 |
| Louisiana | 1,695,022 | .80 | 1,908,484 | .90 |
| Maine | 392,568 | .46 | 411,716 | .48 |
| Maryland | 1,841,631 | 1.10 | 1,612,035 | .96 |
| Massachusetts [2] | 2,065,685 | .47 | 1,958,035 | .44 |
| Michigan | 5,359,971 | 1.11 | 5,288,904 | 1.10 |
| Minnesota | 2,552,950 | .96 | 2,394,117 | .90 |
| Mississippi [2] | 1,815,516 | .90 | 2,019,522 | 1.00 |
| Missouri | 3,131,558 | .79 | 2,787,556 | .70 |
| Montana | 820,101 | 1.52 | 391,573 | .73 |
| Nebraska | 1,190,879 | .87 | 1,102,230 | .81 |
| Nevada [2] | 110,066 | 1.09 | 127,842 | 1.27 |
| New Hampshire [2] | 345,129 | .68 | 289,235 | .57 |
| New Jersey | 3,857,647 | .89 | 3,423,585 | .79 |
| New Mexico [2] | 825,183 | 1.96 | 891,119 | 2.11 |
| New York | 11,111,639 | .86 | 10,823,514 | .84 |
| North Carolina [2] | 1,432,289 | .41 | 1,648,790 | .47 |
| North Dakota [2] | 274,695 | .39 | 279,648 | .40 |
| Ohio | 5,419,879 | .80 | 5,265,862 | .78 |
| Oklahoma | 2,098,722 | .82 | 1,900,253 | .75 |
| Oregon | 762,281 | .74 | 669,471 | .65 |
| Pennsylvania | 7,212,509 | .71 | 6,068,337 | .60 |
| Rhode Island [2] | 422,468 | .62 | 371,918 | .55 |
| South Carolina [2] | 733,620 | .39 | 768,781 | .41 |
| South Dakota | 525,760 | .76 | 393,566 | .57 |
| Tennessee | 2,082,411 | .72 | 1,969,645 | .68 |
| Texas | 5,913,929 | .96 | 6,271,197 | 1.02 |
| Utah | 499,813 | .96 | 479,141 | .92 |
| Vermont [2] | 295,460 | .77 | 221,915 | .58 |
| Virginia | 1,668,227 | .62 | 2,307,481 | .85 |
| Washington | 4,107,432 | 2.48 | 2,237,035 | 1.35 |
| West Virginia | 1,325,125 | .71 | 1,021,349 | .55 |
| Wisconsin | 3,000,657 | 1.03 | 2,620,103 | .90 |
| Wyoming | 395,262 | 1.68 | 496,988 | 2.11 |
| Unspecified | 51,483 | | 18,539 | |
| | 112,782,328 | .87 | 105,042,829 | .81 |
| Exports reported by manufacturers but not included above [3] | 1,022,454 | | 1,281,298 | |
| Total shipped from cement plants | 113,804,782 | | 106,324,127 | |

[1] Per capita figures based on latest available estimates of population made by the Bureau of the Census.
[2] Non-cement-producing State.
[3] Includes shipments to Alaska, Hawaii, and Puerto Rico.

The following table of monthly shipments from portland-cement mills into States in 1938 is based on monthly reports of producers. Although the totals may vary slightly from figures shown in tables based on annual reports they reflect the seasonal fluctuations with fair accuracy.

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*Portland cement shipped from mills into States in 1938, by months, in barrels*

| Shipped to— | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 101,086 | 98,813 | 99,317 | 76,502 | 122,089 | 128,362 | 114,216 | 124,246 | 112,298 | 124,001 | 109,344 | 100,523 |
| Alaska | 139 | 812 | | | | | 150 | 125 | 263 | | | |
| Arizona | 58,297 | 64,882 | 39,120 | 53,323 | 64,281 | 70,954 | 45,703 | 68,500 | 50,107 | 65,342 | 61,878 | 62,081 |
| Arkansas | 30,448 | 28,249 | 47,705 | 66,980 | 56,511 | 57,739 | 54,258 | 65,736 | 100,653 | 92,096 | 96,424 | 79,758 |
| California | 692,734 | 496,117 | 644,724 | 790,235 | 858,852 | 895,874 | 743,945 | 945,510 | 845,456 | 894,624 | 773,009 | 677,103 |
| Colorado | 39,016 | 39,361 | 60,866 | 79,537 | 88,096 | 87,326 | 77,323 | 82,565 | 86,447 | 99,604 | 65,963 | 50,406 |
| Connecticut | 29,518 | 40,340 | 74,713 | 136,235 | 170,157 | 138,833 | 139,708 | 133,037 | 141,235 | 170,773 | 116,164 | 73,076 |
| Delaware | 7,412 | 10,652 | 20,639 | 17,658 | 22,825 | 27,056 | 37,862 | 44,648 | 38,805 | 33,576 | 21,298 | 11,404 |
| District of Columbia | 42,947 | 46,470 | 65,321 | 84,342 | 89,551 | 121,639 | 91,683 | 121,962 | 98,728 | 101,855 | 77,291 | 60,898 |
| Florida | 93,983 | 95,790 | 82,649 | 101,901 | 91,950 | 96,167 | 100,792 | 110,486 | 98,616 | 124,182 | 115,157 | 132,511 |
| Georgia | 91,283 | 100,196 | 131,910 | 121,172 | 113,557 | 96,276 | 97,446 | 134,986 | 135,181 | 118,967 | 98,034 | 84,635 |
| Hawaii | 37,720 | 26,969 | 36,215 | 19,322 | 20,692 | 27,137 | 20,250 | 23,285 | 17,768 | 20,612 | 30,045 | 23,371 |
| Idaho | 9,770 | 17,347 | 28,029 | 37,756 | 41,355 | 41,784 | 33,640 | 39,820 | 41,435 | 42,870 | 28,590 | 20,705 |
| Illinois | 135,402 | 172,662 | 407,554 | 422,934 | 480,206 | 588,835 | 675,301 | 838,281 | 839,549 | 1,023,274 | 536,772 | 311,095 |
| Indiana | 66,651 | 86,221 | 174,574 | 197,245 | 236,397 | 272,709 | 296,656 | 452,264 | 385,724 | 357,162 | 196,656 | 120,043 |
| Iowa | 32,666 | 58,354 | 128,960 | 175,454 | 289,843 | 423,793 | 428,888 | 513,725 | 476,711 | 494,623 | 138,190 | 64,031 |
| Kansas | 85,500 | 79,541 | 153,824 | 147,779 | 140,019 | 154,500 | 125,906 | 148,242 | 195,759 | 183,878 | 122,090 | 108,557 |
| Kentucky | 61,614 | 54,930 | 108,474 | 189,013 | 190,784 | 216,946 | 195,268 | 218,472 | 232,792 | 269,710 | 159,067 | 87,963 |
| Louisiana | 136,985 | 149,821 | 173,795 | 139,081 | 154,345 | 197,070 | 162,353 | 146,861 | 185,504 | 169,808 | 139,570 | 153,821 |
| Maine | 7,995 | 5,905 | 9,689 | 25,035 | 41,133 | 57,860 | 60,699 | 53,111 | 53,105 | 56,130 | 23,577 | 17,382 |
| Maryland | 52,255 | 76,399 | 109,952 | 156,723 | 152,549 | 150,239 | 154,332 | 179,425 | 149,826 | 198,013 | 136,358 | 95,124 |
| Massachusetts | 50,512 | 62,890 | 125,681 | 162,261 | 189,515 | 183,418 | 216,956 | 180,898 | 272,023 | 189,449 | 177,295 | 147,174 |
| Michigan | 140,241 | 152,343 | 282,273 | 479,871 | 484,329 | 630,238 | 493,054 | 679,045 | 693,636 | 645,942 | 434,632 | 213,611 |
| Minnesota | 42,394 | 74,978 | 154,968 | 165,973 | 224,834 | 317,927 | 253,271 | 261,335 | 361,678 | 330,926 | 122,179 | 83,254 |
| Mississippi | 70,030 | 100,968 | 157,807 | 165,891 | 218,261 | 186,906 | 188,397 | 220,197 | 231,012 | 239,786 | 151,159 | 94,683 |
| Missouri | 95,441 | 91,661 | 192,494 | 222,651 | 214,512 | 306,263 | 270,340 | 307,296 | 304,307 | 346,887 | 271,908 | 163,374 |
| Montana | 18,317 | 19,250 | 26,220 | 38,631 | 33,658 | 39,071 | 40,759 | 44,357 | 46,476 | 43,319 | 21,843 | 19,604 |
| Nebraska | 33,354 | 33,212 | 78,259 | 69,109 | 71,184 | 108,873 | 112,123 | 138,722 | 174,441 | 170,028 | 72,785 | 39,968 |
| Nevada | 6,294 | 5,228 | 8,263 | 14,111 | 13,877 | 13,919 | 9,936 | 12,582 | 10,917 | 12,033 | 10,206 | 8,968 |
| New Hampshire | 6,173 | 7,221 | 15,635 | 31,893 | 29,254 | 37,112 | 45,410 | 21,150 | 33,628 | 24,385 | 23,570 | 13,731 |
| New Jersey | 122,198 | 142,307 | 257,368 | 308,909 | 355,526 | 364,826 | 362,901 | 369,706 | 370,559 | 341,775 | 259,037 | 169,072 |
| New Mexico | 57,872 | 65,787 | 80,390 | 100,529 | 82,495 | 98,062 | 73,889 | 64,371 | 52,404 | 77,285 | 91,279 | 65,908 |
| New York | 357,211 | 398,397 | 720,967 | 928,573 | 1,113,991 | 1,238,272 | 1,211,944 | 1,189,801 | 1,127,421 | 1,110,777 | 818,291 | 587,254 |
| North Carolina | 68,633 | 87,510 | 152,190 | 151,529 | 165,294 | 134,852 | 129,700 | 163,822 | 164,672 | 152,642 | 163,800 | 114,535 |
| North Dakota | 4,545 | 2,922 | 20,337 | 31,599 | 32,467 | 46,333 | 32,219 | 28,899 | 29,320 | 36,440 | 9,668 | 4,844 |
| Ohio | 168,225 | 173,929 | 338,151 | 441,436 | 466,437 | 539,073 | 526,860 | 618,494 | 577,149 | 724,919 | 435,666 | 262,499 |
| Oklahoma | 138,781 | 95,970 | 162,812 | 156,193 | 172,549 | 150,479 | 145,037 | 223,229 | 178,551 | 170,026 | 155,720 | 148,039 |
| Oregon | 29,198 | 33,496 | 46,400 | 58,432 | 56,414 | 63,027 | 61,096 | 91,322 | 85,714 | 62,910 | 42,456 | 39,028 |
| Pennsylvania | 223,463 | 260,908 | 420,782 | 550,107 | 650,216 | 699,241 | 643,658 | 696,319 | 576,714 | 643,128 | 428,107 | 272,822 |
| Puerto Rico | 12,841 | 40,835 | 36,839 | 45,270 | 49,514 | 34,732 | 25,219 | 35,985 | 34,459 | 19,460 | 32,392 | 31,960 |
| Rhode Island | 6,494 | 10,891 | 26,975 | 37,381 | 37,697 | 49,024 | 48,655 | 35,548 | 54,221 | 26,460 | 29,518 | 22,600 |
| South Carolina | 51,800 | 62,542 | 60,650 | 55,755 | 72,750 | 85,984 | 56,704 | 70,363 | 62,437 | 70,376 | 64,116 | 60,079 |
| South Dakota | 8,196 | 13,195 | 33,155 | 33,497 | 32,925 | 47,428 | 39,368 | 39,979 | 44,309 | 62,762 | 23,785 | 14,904 |
| Tennessee | 77,260 | 71,927 | 103,584 | 129,204 | 160,978 | 223,894 | 183,442 | 198,026 | 180,382 | 271,376 | 176,268 | 180,447 |
| Texas | 480,162 | 469,792 | 574,458 | 522,614 | 548,206 | 563,712 | 428,557 | 505,923 | 538,972 | 576,851 | 552,228 | 508,444 |
| Utah | 10,806 | 15,423 | 25,482 | 44,953 | 47,916 | 53,946 | 39,565 | 49,562 | 61,081 | 62,030 | 40,400 | 27,915 |

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*Portland cement shipped from mills into States in 1938, by months, in barrels*—Continued

| Shipped to— | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vermont | 2,489 | 3,021 | 7,937 | 21,235 | 32,972 | 28,744 | 25,462 | 25,215 | 25,579 | 29,047 | 18,979 | 8,671 |
| Virginia | 99,963 | 112,444 | 163,572 | 211,858 | 201,986 | 221,805 | 217,584 | 284,906 | 230,916 | 239,894 | 181,242 | 133,757 |
| Washington | 56,227 | 57,707 | 89,912 | 130,121 | 127,085 | 125,631 | 153,388 | 176,556 | 273,508 | 388,208 | 387,924 | 270,317 |
| West Virginia | 41,153 | 45,384 | 66,116 | 77,365 | 76,375 | 93,662 | 92,360 | 122,164 | 112,488 | 114,842 | 80,352 | 54,228 |
| Wisconsin | 46,046 | 51,189 | 116,145 | 173,334 | 250,097 | 285,544 | 271,303 | 392,886 | 391,910 | 377,432 | 171,822 | 91,971 |
| Wyoming | 8,580 | 26,403 | 40,795 | 47,135 | 52,934 | 60,625 | 57,250 | 64,889 | 66,368 | 48,508 | 13,049 | 10,435 |
| Unspecified | 21,759 | 1,026 | 18,348 | 13,000 | 11,016 | 28,144 | 1,000 | 27,251 | 18,466 | 23,207 | 14,795 | 16,643 |
| | 4,370,079 | 4,540,587 | 7,202,995 | 8,658,647 | 9,702,456 | 10,911,866 | 10,113,786 | 11,786,085 | 11,671,680 | 12,274,210 | 8,521,948 | 6,215,226 |
| Foreign countries | 19,921 | 34,413 | 56,005 | 32,353 | 49,544 | 31,134 | 50,214 | 36,915 | 44,320 | 82,790 | 51,052 | 74,774 |
| Total shipped from cement plants | 4,390,000 | 4,575,000 | 7,259,000 | 8,691,000 | 9,752,000 | 10,943,000 | 10,164,000 | 11,823,000 | 11,716,000 | 12,357,000 | 8,573,000 | 6,290,000 |

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The Bureau of Mines has no facilities for collecting statistics on the consumption of portland cement by uses. The following estimates were made by engineers of the Portland Cement Association, who are in touch with various industries throughout the country that use cement.

*Estimated distribution of portland cement in the United States in 1937, by uses*[1]

| Classification | Percent | Barrels |
|---|---|---|
| Paving: Roads, streets, and airports | 23 | 25,940,000 |
| Structural: Buildings, bridges, and railroads | 32 | 36,090,000 |
| Conservation: Reclamation, water supply, and sewerage | 19 | 21,430,000 |
| Housing and miscellaneous uses | 17 | 18,040,000 |
| Farm | 9 | 11,280,000 |
| | 100 | 112,780,000 |

[1] Compiled by the Portland Cement Association; based on analyses of construction figures and other data.

## LOCAL SUPPLIES

The following table compares the shipments from mills within a State or group of States with the estimated consumption (State receipts of mill shipments) and indicates the surplus or deficiency in the supply of cement locally available. Consumption in the States that do not produce cement is also indicated in the table showing consumption per capita.

The surplus in the following table was distributed by years as follows: In 1937, to non-cement-producing States 11,726,959 barrels, foreign countries and Alaska, Hawaii, and Puerto Rico 1,022,454 barrels, and unspecified 51,483 barrels; in 1938, to non-cement-producing States 11,947,543 barrels, foreign countries and Alaska, Hawaii, and Puerto Rico 1,281,298 barrels, and unspecified, 18,539 barrels.

*Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1937–38, in barrels*

| State or division | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Shipments from mills | Estimated consumption | Surplus or deficiency | Shipments from mills | Estimated consumption | Surplus or deficiency |
| Alabama | 4,403,459 | 1,224,480 | +3,178,979 | 4,548,079 | 1,310,975 | +3,237,104 |
| California | 11,877,642 | 10,628,696 | +1,248,946 | 10,539,010 | 9,216,358 | +1,322,652 |
| Illinois | 4,713,734 | 6,945,077 | −2,231,343 | 4,357,119 | 6,432,231 | −2,075,112 |
| Iowa | 4,598,453 | 3,248,502 | +1,349,951 | 4,759,390 | 3,226,718 | +1,532,672 |
| Kansas | 3,500,684 | 1,949,506 | +1,551,178 | 3,217,497 | 1,645,844 | +1,571,653 |
| Michigan | 7,831,880 | 5,359,971 | +2,471,909 | 7,192,511 | 5,288,904 | +1,903,607 |
| Missouri | 4,565,448 | 3,131,558 | +1,433,890 | 4,570,389 | 2,787,556 | +1,782,833 |
| Ohio | 5,501,769 | 5,419,879 | +81,890 | 5,258,603 | 5,265,862 | −7,259 |
| Pennsylvania | 22,952,603 | 7,212,509 | +15,740,094 | 21,082,966 | 6,068,337 | +15,014,629 |
| Tennessee | 3,013,817 | 2,082,411 | +931,406 | 3,390,871 | 1,969,645 | +1,421,226 |
| Texas | 6,687,719 | 5,913,929 | +773,790 | 7,116,545 | 6,271,197 | +845,348 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 3,000,825 | 3,242,810 | −241,985 | 2,705,161 | 2,607,045 | +98,116 |
| Oregon and Washington | 4,644,984 | 4,869,713 | −224,729 | 2,716,270 | 2,906,506 | −190,236 |
| Georgia, Kentucky, Virginia, Florida, and Louisiana | 4,398,485 | 7,854,890 | −3,456,405 | 4,954,431 | 8,760,486 | −3,806,055 |
| Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas | 12,250,785 | 13,391,345 | −1,140,560 | 10,615,153 | 12,026,884 | −1,411,731 |
| Maryland, New Jersey, and West Virginia | 3,334,233 | 7,024,403 | −3,690,170 | 3,115,611 | 6,056,969 | −2,941,358 |
| New York and Maine | 6,528,262 | 11,504,207 | −4,975,945 | 6,184,521 | 11,235,230 | −5,050,709 |
| | 113,804,782 | 101,003,886 | +12,800,896 | 106,324,127 | 93,076,747 | +13,247,380 |

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## PRICES

The average selling price of portland cement, f. o. b. factories (excluding the price of containers and cash discounts), as reported to the Bureau of Mines, is stated in the table of shipments by States and districts during 1937 and 1938, on a preceding page. The average factory value of portland cement may be higher in certain States than it would be if ordinary structural cement were the only kind considered. For these States the average includes certain special cements that command higher prices, including the white portland cement made in California and Pennsylvania and the high-early-strength portland cement now manufactured in many States. The average selling price per barrel, f. o. b. factory, of white portland cement in 1938 was $3.66; in 1937, $3.77. The average factory selling price of high-early-strength portland cement was $1.85 per barrel in 1938 and $1.86 per barrel in 1937. The sales value of other hydraulic cements is given later in this chapter.

The following table shows the average factory value of portland cement from 1934 through 1938.

*Average factory value per barrel in bulk of portland cement in the United States, 1934–38*

| | | | |
|---|---|---|---|
| 1934 | $1.54 | 1937 | $1.48 |
| 1935 | 1.51 | 1938 | 1.45 |
| 1936 | 1.51 | | |

## CAPACITY

At the end of 1938, the capacity for producing finished portland cement of the 151 plants active and shipping in 1938 and the 11 plants inactive in 1938 but producing or shipping from stock on hand within the 7 previous years is shown in the following table with similar figures for 1937. Figures for plant capacity are based on manufacturers' reports, supplemented by a few estimates.

*Portland-cement manufacturing capacity of the United States, 1937–38, by commercial districts*

| District | Estimated capacity (barrels) | | Percent of capacity utilized | |
|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 |
| Eastern Pennsylvania, New Jersey, and Maryland | 50,712,000 | 50,712,000 | 41.8 | 39.2 |
| New York and Maine | 17,199,000 | 17,124,000 | 37.0 | 36.5 |
| Ohio, western Pennsylvania, and West Virginia | 28,677,000 | 28,447,000 | 37.6 | 33.0 |
| Michigan | 16,605,000 | 16,605,000 | 49.3 | 43.1 |
| Wisconsin, Illinois, Indiana, and Kentucky | 29,046,000 | 29,046,000 | 43.9 | 34.2 |
| Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana | 25,855,000 | 25,755,000 | 42.6 | 46.7 |
| Eastern Missouri, Iowa, Minnesota, and South Dakota | 23,017,000 | 22,917,000 | 46.4 | 43.6 |
| Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas | 17,159,000 | 17,159,000 | 50.4 | 44.3 |
| Texas | 11,742,000 | 12,042,000 | 58.8 | 57.7 |
| Colorado, Montana, Utah, Wyoming, and Idaho | 6,125,000 | 6,125,000 | 49.9 | 43.9 |
| California | 22,241,000 | 22,820,000 | 53.7 | 46.1 |
| Oregon and Washington | 6,845,000 | 6,945,000 | 67.6 | 42.9 |
| | 255,223,000 | 255,697,000 | 45.5 | 41.2 |

The following estimates, based on the monthly reports of producers, of the relation between the production of finished portland cement and the manufacturing capacity of the industry for each month in1937 and 1938 and for the 12 months ended with each month indicate the seasonal changes in capacity utilized.

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*Ratio (percent) of finished portland cement produced to manufacturing capacity of the United States, 1937–38*

| Month | Monthly | | 12 months ended— | | Month | Monthly | | 12 months ended— | |
|---|---|---|---|---|---|---|---|---|---|
| | 1937 | 1938 | 1937 | 1938 | | 1937 | 1938 | 1937 | 1938 |
| January | 30.4 | 20.7 | 44.9 | 44.5 | July | 53.1 | 50.2 | 47.8 | 40.8 |
| February | 29.6 | 19.8 | 45.8 | 43.7 | August | 54.4 | 50.4 | 47.6 | 40.4 |
| March | 38.6 | 26.9 | 47.0 | 42.7 | September | 53.1 | 49.9 | 47.1 | 40.2 |
| April | 48.8 | 37.7 | 47.6 | 41.8 | October | 52.0 | 52.9 | 46.7 | 40.2 |
| May | 53.2 | 47.4 | 47.9 | 41.3 | November | 43.7 | 48.2 | 46.0 | 40.6 |
| June | 52.8 | 49.8 | 47.8 | 41.0 | December | 32.2 | 36.9 | 45.3 | 41.0 |

The following table gives statistics of capacity, 1936–38, by the two general methods—the "wet" and the "dry"—used in manufacturing portland cement at plants in the United States:

*Portland-cement manufacturing capacity of the United States, 1936–38, by processes*

| Process | Estimated capacity | | | | | | Percent of capacity utilized | | | Percent of total finished cement produced | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thousands of barrels | | | Percent of total | | | | | | | | |
| | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 | 1936 | 1937 | 1938 |
| Wet | 122,727 | 122,638 | 119,776 | 48.0 | 48.1 | 46.8 | 46.3 | 49.2 | 46.1 | 50.5 | 51.9 | 52.4 |
| Dry | 132,777 | 132,585 | 135,921 | 52.0 | 51.9 | 53.2 | 42.0 | 42.1 | 36.9 | 49.5 | 48.1 | 47.6 |
| | 255,504 | 255,223 | 255,697 | 100.0 | 100.0 | 100.0 | 44.1 | 45.5 | 41.2 | 100.0 | 100.0 | 100.0 |

## RAW MATERIALS

In 1938 producers reported that approximately 32,234,000 short tons of raw materials (exclusive of fuels and explosives) entered into the manufacture of 105,357,000 barrels (19,807,116 short tons) of portland cement in the United States, an average of about 612 pounds to a barrel of finished cement (376 pounds).

The totals were as follows: 26,183,000 tons of limestone and cement rock, 3,054,000 tons of clay and shale (including kaolin for the manufacture of white cement), 428,000 tons of blast-furnace slag, 618,000 tons of marl, 93,000 tons of iron ore, 663,000 tons of gypsum, and 1,195,000 tons of other materials, such as oystershells, sandstone, sand (including glass and silica sand), cinders, fluorspar, diatomite, diatomaceous shale, fuller's earth, bentonite, silica, quartz, ashes, pyrite ore, and pyrite cinder. In cements like the puzzolan portlands, which require highly siliceous materials in their manufacture, the use of a wider variety of materials, such as diatomite, diatomaceous earth and shale, pumicite, and tufa, is being reported.

*Gypsum and anhydrite.*—About 3 percent by weight of gypsum (or gypsum and anhydrite mixtures) is added to the cement clinker at the time of grinding to retard the time of setting. Data [1] on the uses of gypsum show that 674,062 short tons of gypsum and anhydrite were used as cement retarder in 1938. This represented 19 percent of the total crude-gypsum supply (domestic and imported) of the country.

[1] Details in the chapter on Gypsum in this volume.

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## MANUFACTURING CONDITIONS AND NEW DEVELOPMENTS

*Plants.*—In 1938 portland cement was manufactured at 149 plants, and shipments were made from 151 plants compared with 149 plants producing and 150 plants shipping in 1937. The new plant of the Gulf Portland Cement Co. at Houston, Tex., began production early in 1938. The new wet-process plant of the Puerto Rico Cement Corporation near San Juan, Puerto Rico, was virtually completed in May 1938, but operation was not reported until January 1939.

Large modernization programs affecting many plants have been reported. A device known as the "electric ear" for controlling the feed of grinding mills has been installed at the Medusa Portland Cement Co. plants at Toledo, Ohio, and York, Pa., and at the Hagerstown (Md.) plant of the North American Cement Corporation. This and many other new developments involving changes from wet to dry process, introduction of Diesel-driven automotive haulage, use of dust-precipitating equipment, and improvements in grinding and calcining have been described in some detail in the technical press.[2]

The use of iron oxide in the cement raw mix is increasing. Single mills in Pennsylvania are using as much as 2,000 tons a year. They employ the lowest-priced material available—roll scale, pyrite cinder, or impure iron ore.

*Specifications.*[3]—The Federal Specifications Executive Committee has been active in issuing specifications on cement. The following have been promulgated: Portland cement, SS–C–191A; high-early-strength, SS–C–201; moderate-heat, SS–C–206; sulfate-resisting, SS–C–211; cements, hydraulic, general specifications (methods for sampling, inspection, and testing), SS–C–158; cement, portland, pozzolana, SS–C–208; and cement, masonry, SS–C–181B. The American Society for Testing Materials has issued a revised tentative specification for masonry cement (C91–T).

The measurement of fineness by surface area of the particles rather than by screen test is now regarded as standard procedure. The Federal specifications mentioned in the preceding paragraph designate the fineness requirement in square centimeters per gram as determined by a Wagner turbidimeter.

*Flotation methods.*—For several years froth flotation has been used successfully at Valley Forge, Pa., for the purification of cement raw materials. A second plant using the process is situated in the Union of South Africa, and recently a third plant has been established at Parma, Argentina. Research on flotation of limestone is now being conducted in the Lehigh Valley cement district of Pennsylvania.

*Fuels.*—According to monthly reports of producers, supplemented by a few estimates by the Bureau of Mines, the following quantities of fuel were consumed at portland-cement plants in the United States in 1938 compared with the production of 104,117,000 barrels of clinker (unground cement) and 105,357,000 barrels of finished cement: Coal, 4,482,663 short tons; oil, 1,927,584 barrels (42 gallons); and natural gas, 37,336,231,988 cubic feet. Corresponding figures for 1937 are:

[2] *See* Pit and Quarry, vol. 31, January 1939, pp. 84–90; Rock Products, vol. 42, February 1939, pp. 31–36, and vol. 42, March 1939, pp. 26–31; Chem. and Met. Eng., vol. 46, March 1939, p. 170.

[3] Copies of Federal specifications may be obtained upon application accompanied by money order, coupon, or cash to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents each. American Society for Testing Materials specifications may be obtained from the office of the secretary of the society, 260 South Broad St., Philadelphia, Pa.

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Clinker produced, 116,843,000 barrels; and finished cement produced, 116,174,708 barrels. Fuels consumed were: Coal, 5,246,537 short tons; oil, 2,398,130 barrels; and natural gas, 40,449,920,245 cubic feet.

*Electric power.*—The accompanying table gives the electric energy produced at portland-cement plants and that purchased from power companies during 1937 and 1938. The table shows that the industry generated 51 percent of the electric power used at manufacturing plants in 1938.

*Electrical energy used at portland-cement producing plants, 1937–38, by processes, in kilowatt-hours*

| Process | Electrical energy used | | | | | | Finished cement produced | Average electrical energy used per barrel of cement produced |
|---|---|---|---|---|---|---|---|---|
| | Generated at portland-cement plants | | Purchased | | Total | | | |
| | Active plants | Kilowatt-hours | Active plants | Kilowatt-hours | Kilowatt-hours | Percent | Barrels | Kilowatt-hours |
| 1937 | | | | | | | | |
| Wet | 34 | 590,184,860 | 71 | 784,662,991 | 1,374,847,851 | 51.2 | 60,334,050 | 22.8 |
| Dry | 37 | 834,243,065 | 51 | 477,552,518 | 1,311,795,583 | 48.8 | 55,840,658 | 23.5 |
| | 71 | 1,424,427,925 | 122 | 1,262,215,509 | 2,686,643,434 | 100.0 | 116,174,708 | 23.1 |
| Percent of total electrical energy used | | 53.0 | | 47.0 | 100.0 | | | |
| 1938 | | | | | | | | |
| Wet | 36 | 483,474,071 | 74 | 767,024,235 | 1,250,498,306 | 51.8 | 55,229,268 | 22.6 |
| Dry | 37 | 749,733,662 | 50 | 416,182,260 | 1,165,915,922 | 48.2 | 50,127,732 | 23.3 |
| | 73 | 1,233,207,733 | 124 | 1,183,206,495 | 2,416,414,228 | 100.0 | 105,357,000 | 22.9 |
| Percent of total electrical energy used | | 51.0 | | 49.0 | 100.0 | | | |

## SPECIAL PORTLAND CEMENTS

Regular or standard portland cements have been greatly improved during recent years. They attain adequate strength for ordinary use in a much shorter time and have higher ultimate strength and better workability than cements made some years ago. Although these cements are well adapted for all ordinary uses, new conditions have arisen in industry that demand cements having special qualities such as high early strength, unusual plasticity, low or moderate heat of setting, or high resistance to chemical action. Special types of portland cement are discussed in the following paragraphs.

*White portland cement.*—White cement has been manufactured for many years in Pennsylvania and since 1932 in California. It is simply a standard cement, the raw materials of which are unusually pure and which has a very low iron content. To avoid contamination and discoloration from fuel these cements are calcined with gas. They are produced at so few plants that the Bureau is not at liberty to publish figures of production separately.

*Alumina cement.*—A product known as alumina or high-alumina cement was first manufactured in France under the name "ciment fondu." Modifications of alumina cement have been made in the

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United States for many years under patent. The raw materials are bauxite and limestone or lime, which are completely fused in a furnace. The melted product is cooled rapidly and ground to a fine powder. Production figures cannot be published separately.

*High-early-strength cement.*—For street work where traffic is heavy, construction work where one step must follow another rapidly, and similar uses, a cement that attains adequate strength in 24 hours or less is much in demand. This has led to the development of special high-early-strength cements that are now manufactured in many States.

*Masonry cement.*—Cements suitable for masonry must be plastic and of low shrinkage.

In addition to "masonry portland" and "masonry natural" (discussed on a following page) producers also report masonry cements, hydraulic but not portland, which evidently are specially prepared from portland-cement clinker and other ingredients. Production of such cements, made at 32 plants in 1938, totaled 1,246,263 barrels and shipments 1,225,960 barrels valued at $1,589,908, an average of $1.30 a barrel. Corresponding data for 1937, representing the output of 20 plants, are: Production 747,678 barrels and shipments 694,389 barrels valued at $970,446, an average of $1.40 a barrel. To avoid duplication the above figures are not included in the portland-cement totals, because portland-cement clinker is evidently the principal constituent used.

*Low and moderate heat-of-hardening portland cement.*—Because of the enormous masses of concrete used in large dams such as those in the Tennessee Valley and the Far West a demand has arisen for cements that develop little heat in the process of setting. They include Tennessee Valley Authority type B and other cements that must conform with Federal specifications recorded earlier in this chapter.

*Portland-puzzolan cement.*—Portland-puzzolan cements, including those reported as "high-silica," are specially adapted for resistance to chemical attack such as the reaction with salts contained in sea water. They are made by adding to portland cement, pumicite, slag, or other materials that react with the calcium content of the cement.

*Oil-well cement.*—In the oil-producing States, particularly California, Texas, and Wyoming, special types of portland cement have been developed that are suitable for grouting wells.

*Miscellaneous.*—Other special portland cements include those suitable for resisting high temperatures.

The following table presents statistical data for recent years insofar as they are available. All figures given in this table except those for masonry cement are included in the general tables appearing earlier in this chapter.

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*Special portland cements produced and shipped in the United States, 1936–38, by kinds*

| Kind and year | Active plants | Production (barrels) | Shipments | | |
|---|---|---|---|---|---|
| | | | Barrels | Value | |
| | | | | Total | Average |
| High-early-strength: | | | | | |
| 1936 | 52 | 2,982,748 | 3,080,849 | $5,904,399 | $1.92 |
| 1937 | 64 | 4,192,959 | 3,845,314 | 7,134,468 | 1.86 |
| 1938 | 72 | 3,340,582 | 3,385,523 | 6,247,699 | 1.85 |
| Masonry or mortar: | | | | | |
| 1936 [1] | 15 | 430,785 | 404,672 | 518,482 | 1.28 |
| 1937 | 10 | 257,385 | 273,144 | 362,807 | 1.33 |
| 1938 | 5 | 84,875 | 88,905 | 124,239 | 1.40 |
| Low and moderate heat: | | | | | |
| 1936 | 28 | 3,660,380 | 3,600,776 | 4,896,786 | 1.36 |
| 1937 | 29 | 3,169,593 | 3,511,674 | 5,008,217 | 1.43 |
| 1938 | 40 | 4,132,237 | 3,730,814 | 5,550,369 | 1.49 |
| Portland-puzzolan: | | | | | |
| 1936 | 8 | 548,207 | 540,788 | 561,942 | 1.04 |
| 1937 | 6 | 260,194 | 294,384 | 417,130 | 1.42 |
| 1938 | 6 | 159,745 | 149,142 | 229,441 | 1.54 |
| Oil well: | | | | | |
| 1936 | 8 | 250,688 | 237,709 | 508,848 | 2.14 |
| 1937 | 9 | 342,316 | 313,064 | 652,960 | 2.09 |
| 1938 | 7 | 226,769 | 220,122 | 457,665 | 2.08 |
| Miscellaneous: | | | | | |
| 1936 | 18 | 1,232,117 | 1,215,938 | 1,747,802 | 1.44 |
| 1937 | 13 | 580,705 | 587,718 | 928,856 | 1.58 |
| 1938 | 16 | 608,777 | 589,663 | 965,970 | 1.64 |

[1] Figures for 1936 not exactly comparable with succeeding years, as they include some masonry cement other than portland for which separate statistics were not compiled prior to 1937.

## NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

The term "masonry cement" is used here to designate certain cements made by calcining argillaceous limestone at a comparatively low temperature and grinding the calcined material to a fine powder. This product is known as "natural" cement. Portland cements that are also used for masonry are discussed under the special portland cements on a previous page.

In addition to portland-puzzolan cements discussed on a previous page, another type known as slag-lime cement is now made at Birmingham and Graystone, Ala., by mixing granulated blast-furnace slag with hydrated lime and grinding them to a fine consistency. The mixture is not subsequently calcined. The Birmingham industry has been described by Cudworth and Mead.[4]

Figures for production and shipments of special types of cement other than portland are presented in the following table.

[4] Cudworth, James R., and Mead, Joseph C., Utilization of Slag in the Birmingham District, Alabama: Am. Inst. Min. and Met. Eng. Tech. Pub. 796, 1937, 9 pp.



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*Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1934–38*

| Year | Production | | Shipments | | Stock (Dec. 31) |
|---|---|---|---|---|---|
| | Active plants | Barrels (376 pounds) | Barrels (376 pounds) | Value | Barrels (376 pounds) |
| 1934 | 14 | 671,588 | 678,204 | $960,732 | 175,865 |
| 1935 | 13 | 1,006,064 | 1,011,411 | 1,437,542 | 172,572 |
| 1936 | 13 | 1,819,488 | 1,760,993 | 2,362,396 | 230,788 |
| 1937 | 12 | 1,900,643 | 1,873,400 | 2,578,885 | 258,031 |
| 1938 | 11 | 1,704,662 | 1,745,541 | 2,558,077 | 196,649 |

## FOREIGN TRADE [5]

*Imports.*—The figures in the following table cover imports of hydraulic cements of all kinds. The values assigned are supposed to represent values in the foreign countries from which the materials are exported, including the cost of containers or coverings. Values ranged in 1938 from $0.93 per barrel for imports from Yugoslavia to $2.02 per barrel for imports from the United Kingdom.

*Hydraulic cement imported for consumption in the United States, 1934–38*

| Year | Barrels | Value | Year | Barrels | Value |
|---|---|---|---|---|---|
| 1934 | 265,997 | $264,416 | 1937 | 1,803,932 | $1,392,633 |
| 1935 | 619,404 | 615,866 | 1938 | 1,727,411 | 1,436,730 |
| 1936 | 1,658,902 | 1,421,620 | | | |

The following table of imports by countries of origin and import districts includes all hydraulic cements except "white nonstaining portland cement," which was reported "imported for consumption" as follows: 1938, 12,227 barrels valued at $38,557, of which 5,439 barrels valued at $17,466 came from Belgium, 3,262 barrels valued at $6,394 from France, and 1,555 barrels valued at $5,892 from the United Kingdom; 1937, 12,808 barrels valued at $39,875, of which 4,214 barrels valued at $13,775 came from Belgium, 3,728 barrels valued at $13,691 from the United Kingdom, and 2,711 barrels valued at $6,000 from France.

[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Roman, portland, and other hydraulic cements imported for consumption in the United States, 1937–38, by countries and districts*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Barrels | Value | Barrels | Value |
| COUNTRY | | | | |
| Belgium | 1,004,290 | $689,830 | 1,168,148 | $852,233 |
| Canada | 14,536 | 14,379 | 1,385 | 3,372 |
| Denmark | 292,054 | 277,848 | 279,317 | 281,551 |
| France | 378 | 931 | 5,053 | 4,465 |
| Germany | 159,210 | 112,869 | 78,365 | 92,268 |
| Italy | | | 645 | 2,769 |
| Japan | 126,484 | 106,442 | 71,574 | 61,351 |
| Mexico | 427 | 1,008 | 149 | 312 |
| Netherlands | 131,507 | 86,620 | 33,872 | 26,169 |
| Norway | 45,249 | 34,492 | 21,238 | 17,072 |
| Poland and Danzig | | | 30,062 | 23,121 |
| United Kingdom | 6,782 | 22,048 | 9,189 | 18,526 |
| Yugoslavia | 10,207 | 6,291 | 16,187 | 14,964 |
| | 1,791,124 | 1,352,758 | 1,715,184 | 1,398,173 |
| DISTRICT | | | | |
| Connecticut | 10,309 | 10,373 | 5,146 | 6,922 |
| El Paso | 134 | 284 | 149 | 312 |
| Florida | 298,520 | 238,162 | 344,238 | 281,414 |
| Galveston | 910 | 648 | 14,702 | 10,070 |
| Georgia | 18,708 | 13,605 | 44,131 | 31,060 |
| Hawaii | 126,084 | 106,014 | 71,573 | 61,351 |
| Los Angeles | 400 | 428 | 50 | 36 |
| Maine and New Hampshire | 630 | 1,845 | 1,383 | 3,368 |
| Maryland | 55,207 | 40,278 | 67,363 | 45,310 |
| Massachusetts | 178,599 | 135,198 | 115,449 | 103,660 |
| Mobile | 61,955 | 42,955 | 43,549 | 31,499 |
| New Orleans | 3,120 | 2,635 | 8,020 | 6,565 |
| New York | 450,914 | 338,462 | 469,217 | 414,081 |
| North Carolina | 6,170 | 4,400 | 1,313 | 891 |
| Oregon | 22,469 | 17,487 | 9,750 | 6,811 |
| Philadelphia | 57,538 | 37,091 | 93,694 | 58,005 |
| Puerto Rico | 384,821 | 279,019 | 263,777 | 213,063 |
| Rhode Island | 25,160 | 12,222 | 13,939 | 9,047 |
| Sabine | 2,097 | 1,642 | 3,200 | 2,549 |
| St. Lawrence | 13 | 63 | | |
| San Antonio | 32,149 | 24,239 | 49,452 | 40,532 |
| San Diego | | | 1,787 | 1,234 |
| San Francisco | 412 | 2,663 | 1,993 | 1,268 |
| South Carolina | 17,243 | 13,056 | 53,406 | 38,455 |
| Vermont | | | 2 | 4 |
| Virgin Islands | 10,454 | 8,862 | 9,519 | 9,294 |
| Washington | 27,108 | 21,127 | 28,382 | 21,372 |
| | 1,791,124 | 1,352,758 | 1,715,184 | 1,398,173 |

*Exports.*—Although the United States is the major cement-producing country of the world, its export trade is small. As indicated in the following table, exports have amounted to less than 1 percent of total domestic shipments during recent years. The value of exports is the actual cost at United States ports as indicated by the shippers on the export declarations.

*Hydraulic cement exported from the United States, 1934–38*

| Year | Barrels | Value | Percent of total shipments from mills |
|---|---|---|---|
| 1934 | 566,171 | $1,133,381 | 0.7 |
| 1935 | 416,099 | 1,012,942 | .6 |
| 1936 | 334,673 | 886,560 | .3 |
| 1937 | 378,554 | 1,044,161 | .3 |
| 1938 | 558,226 | 1,294,883 | .5 |

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The following table shows exports by country of destination in 1937 and 1938.

*Hydraulic cement exported from the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Barrels | Value | Barrels | Value |
| North America: | | | | |
| Bermuda | 645 | $1,577 | 1,334 | $2,316 |
| Canada | 10,419 | 50,237 | 9,147 | 41,052 |
| Central America: | | | | |
| British Honduras | 4,212 | 6,436 | 4,228 | 6,088 |
| Costa Rica | 350 | 1,696 | 1,309 | 2,886 |
| Guatemala | 5,028 | 7,194 | 142 | 257 |
| Honduras | 9,031 | 13,956 | 7,100 | 10,627 |
| Nicaragua | 3,318 | 6,269 | 1,837 | 3,154 |
| Panama | 85,693 | 177,751 | 94,247 | 196,326 |
| Salvador | 310 | 1,119 | 300 | 1,312 |
| Mexico | 21,658 | 62,761 | 23,438 | 68,350 |
| Newfoundland and Labrador | 1,580 | 7,112 | 676 | 1,506 |
| West Indies: | | | | |
| British: | | | | |
| Jamaica | 94 | 459 | 260 | 752 |
| Trinidad and Tobago | 1,151 | 3,490 | 710 | 2,466 |
| Other British | 1,576 | 4,339 | 1,220 | 3,357 |
| Cuba | 16,988 | 76,441 | 12,309 | 52,407 |
| Dominican Republic | 2,300 | 5,928 | 2,128 | 6,609 |
| French | | | 10 | 11 |
| Haiti | 729 | 1,892 | 3,027 | 4,415 |
| Netherland | 3,056 | 8,396 | 10,428 | 26,082 |
| | 168,138 | 437,053 | 173,850 | 429,973 |
| South America: | | | | |
| Argentina | 29,027 | 125,912 | 35,181 | 149,505 |
| Bolivia | 1,180 | 3,086 | 175 | 881 |
| Brazil | 16,342 | 68,464 | 11,843 | 47,333 |
| Chile | 4,200 | 21,027 | 5,413 | 27,222 |
| Colombia | 11,898 | 32,951 | 20,635 | 55,817 |
| Ecuador | 1,776 | 6,994 | 503 | 2,172 |
| Guiana: French | 165 | 355 | | |
| Paraguay | 10 | 32 | 75 | 368 |
| Peru | 2,512 | 11,553 | 3,675 | 16,667 |
| Uruguay | 4,999 | 20,914 | 1,887 | 7,048 |
| Venezuela | 115,829 | 209,582 | 216,943 | 377,301 |
| Other South America | | | 500 | 830 |
| | 187,938 | 500,870 | 296,830 | 685,144 |
| Europe: | | | | |
| Belgium | 1,395 | 6,103 | 874 | 3,899 |
| Ireland | 270 | 1,221 | 284 | 1,479 |
| Netherlands | 375 | 1,971 | 458 | 2,279 |
| United Kingdom | 9,251 | 38,558 | 5,964 | 24,007 |
| Other Europe | 502 | 2,559 | 194 | 1,340 |
| | 11,793 | 50,412 | 7,774 | 33,004 |
| Asia: | | | | |
| British Malaya | 465 | 1,942 | 315 | 1,193 |
| China | 9 | 29 | 7 | 70 |
| India, British | 1,280 | 6,891 | 1,275 | 6,498 |
| Palestine | 132 | 622 | 132 | 622 |
| Philippine Islands | 942 | 4,905 | 70,327 | 104,538 |
| Saudi Arabia | 500 | 2,299 | 1,932 | 7,207 |
| Other Asia | 2,768 | 15,238 | 3,317 | 14,429 |
| | 6,096 | 31,926 | 77,305 | 134,557 |

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*Hydraulic cement exported from the United States, 1937–38, by countries*—Continued

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Barrels | Value | Barrels | Value |
| Africa: | | | | |
| Egypt | 300 | $1,425 | 140 | $913 |
| Portuguese | 30 | 166 | 48 | 197 |
| Union of South Africa | 1,314 | 6,359 | 1,455 | 7,383 |
| Other Africa | | | 35 | 166 |
| | 1,644 | 7,950 | 1,678 | 8,659 |
| Oceania: | | | | |
| British: | | | | |
| Australia | 1,981 | 12,807 | 499 | 2,178 |
| New Zealand | 312 | 1,152 | 285 | 1,351 |
| Other | 1 | 5 | 5 | 17 |
| French | 651 | 1,986 | | |
| | 2,945 | 15,950 | 789 | 3,546 |
| | 378,554 | 1,044,161 | 558,226 | 1,294,883 |

The following table shows shipments of cement to outlying Territories of the United States in 1937 and 1938.

*Domestic hydraulic cement shipped to noncontiguous Territories of the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Barrels | Value | Barrels | Value |
| Alaska | 27,847 | $75,727 | 40,982 | $112,692 |
| American Samoa | 10 | 25 | 3 | 6 |
| Guam | | | 2 | 14 |
| Hawaii | 229,336 | 504,596 | 321,578 | 710,573 |
| Midway Island[1] | 13 | 44 | 28 | 88 |
| Puerto Rico | 357,562 | 519,293 | 418,521 | 574,033 |
| Virgin Islands | 15,525 | 28,306 | 14,017 | 27,905 |
| Wake Island | 43 | 148 | 10 | 43 |
| | 630,336 | 1,128,139 | 795,141 | 1,425,354 |

[1] Beginning July 1, 1937.

## WORLD PRODUCTION

The following table of world production was compiled for the first time by the Bureau of Mines from consular reports, official statistics, and trade literature. The figures are in metric tons (1 metric ton equals 2,204.6 pounds). The table shows production from 1934 to 1938, inclusive, and the latest reported plant capacity. Although figures for certain countries are still lacking the table presents the most complete picture of the cement industry throughout the world that has yet appeared. Figures on capacity are the best estimates that can be made from available data and are subject to revision.

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*World production of cement, 1934–38, and latest reported capacity, by countries, in metric tons* [1]

[Compiled by R. B. Miller]

| Country | Latest reported capacity [2] | Production | | | | |
|---|---|---|---|---|---|---|
| | | 1934 | 1935 | 1936 | 1937 | 1938 |
| North America: | | | | | | |
| Canada | 2,390,000 | 553,145 | 553,679 | 784,103 | 975,231 | 882,376 |
| Cuba | (3) | (3) | (3) | (3) | (3) | (4) |
| Mexico | (3) | (3) | 251,651 | 285,978 | 344,693 | (4) |
| United States | 43,609,082 | 13,374,408 | 13,259,847 | 19,522,716 | 20,137,732 | 18,259,349 |
| South America: | | | | | | |
| Argentina | 1,045,000 | 567,000 | 721,564 | 833,631 | 1,010,000 | (4) |
| Bolivia | (3) | 26,815 | 40,212 | 61,841 | (3) | (4) |
| Brazil | 830,000 | 323,911 | 362,999 | 483,023 | 571,452 | [5] 650,000 |
| Chile | 425,000 | 203,416 | 284,885 | 248,424 | 313,110 | 363,987 |
| Colombia | (3) | 71,018 | 77,000 | 104,465 | 123,175 | (4) |
| Ecuador | 20,000 | (3) | 13,674 | (3) | (3) | (4) |
| Peru | 120,000 | 45,576 | 60,296 | 75,115 | 83,048 | 101,707 |
| Uruguay | 200,000 | 106,213 | 99,778 | 111,073 | 147,773 | (4) |
| Venezuela | 50,000 | (3) | (3) | (3) | (3) | (4) |
| Europe: | | | | | | |
| Albania | (3) | (3) | (3) | 8,000 | 14,000 | (4) |
| Belgium | 4,000,000 | 1,900,000 | 2,200,000 | 2,350,000 | (3) | (4) |
| Bulgaria | 240,000 | 114,000 | 105,000 | 113,000 | 135,000 | (4) |
| Czechoslovakia | 2,300,000 | 900,000 | 958,000 | 1,050,000 | 1,360,000 | (4) |
| Denmark | 938,000 | 769,563 | 756,823 | 792,369 | 676,125 | (4) |
| Esthonia | (3) | 31,723 | 37,990 | 50,611 | 65,931 | 79,740 |
| Finland | 640,000 | 228,062 | 269,315 | 332,557 | 410,371 | (4) |
| France | 10,012,000 | 4,872,100 | 4,403,800 | 4,638,400 | (3) | (4) |
| Germany | 17,000,000 | 6,470,000 | 8,807,000 | 11,689,000 | 12,605,000 | (4) |
| Austria | 900,000 | 310,000 | 370,000 | 380,000 | 426,000 | (4) |
| Greece | 280,000 | 248,000 | 273,000 | 276,850 | (3) | (4) |
| Hungary | 876,000 | 225,000 | 280,000 | 215,000 | (3) | (4) |
| Italy | 6,000,000 | 4,076,105 | 4,223,118 | 3,826,548 | 4,359,112 | (4) |
| Latvia | 170,000 | 69,553 | 72,013 | 100,213 | 122,426 | (4) |
| Netherlands | 470,000 | 394,000 | 360,000 | 401,000 | 441,000 | (4) |
| Norway | 358,000 | 249,453 | 263,127 | 300,658 | 320,481 | (4) |
| Poland | 1,850,000 | 720,788 | 842,604 | 1,048,270 | 1,289,108 | 1,719,452 |
| Portugal | 260,000 | 185,146 | 214,000 | 245,343 | 254,000 | (4) |
| Rumania | 1,200,000 | 314,350 | 361,000 | 376,000 | 456,311 | (4) |
| Spain | 2,600,000 | 1,362,000 | [5] 1,355,000 | (3) | (3) | (4) |
| Sweden | (3) | 583,196 | 739,630 | 795,181 | 875,541 | (4) |
| Switzerland | 1,200,000 | (3) | (3) | 509,000 | (3) | (4) |
| U. S. S. R. | 6,000,000 | 3,532,808 | 4,488,600 | 5,849,700 | 5,873,000 | (4) |
| United Kingdom | 10,000,000 | 5,280,000 | 5,900,000 | 6,700,000 | 7,300,000 | (4) |
| Yugoslavia | 1,680,000 | 670,000 | 785,000 | 643,072 | 618,635 | (4) |
| Asia: | | | | | | |
| China | 1,170,000 | (3) | (3) | [5] 450,000 | (3) | (4) |
| Manchuria | 1,010,000 | 232,600 | 378,000 | 580,000 | [5] 800,000 | (4) |
| Chosen | 1,600,000 | 222,000 | 460,000 | 567,000 | 665,000 | (4) |
| India, British | 1,465,000 | 767,000 | 892,000 | 977,000 | 1,142,000 | (4) |
| Indochina | 250,000 | 115,000 | 107,000 | 149,230 | 234,638 | (4) |
| Iran | 125,000 | (3) | (3) | (3) | (3) | (4) |
| Japan | 13,100,000 | 4,664,570 | 5,876,803 | 6,232,206 | 6,703,328 | (4) |
| Levant | (3) | ---------- | 100,000 | 136,000 | 175,700 | (4) |
| Netherland India | 235,000 | 113,000 | 140,000 | 136,000 | (3) | (4) |
| Palestine | (3) | 143,000 | 187,000 | 165,000 | 158,000 | (4) |
| Philippine Islands | (3) | 95,685 | 110,825 | 132,910 | 148,000 | (4) |
| Siam | 120,000 | 51,000 | 49,000 | 62,000 | 77,000 | (4) |
| Syria | (3) | 20,000 | 33,450 | 58,000 | 74,000 | 65,516 |
| Turkey | 350,000 | 168,500 | 131,175 | 177,506 | 214,794 | (4) |
| Africa: | | | | | | |
| Algeria | (3) | 96,240 | 64,700 | 66,800 | 67,000 | (4) |
| Belgian Congo | 40,000 | 10,000 | 7,632 | 11,420 | 18,000 | (4) |
| Egypt | 700,000 | 296,837 | 378,780 | 335,000 | 330,000 | (4) |
| Madagascar | 70,000 | 13,000 | 4,000 | ---------- | ---------- | (4) |
| Morocco, French | (3) | 185,000 | 189,000 | 161,780 | 156,000 | (4) |
| Mozambique | 30,000 | 11,531 | 12,572 | 11,826 | 14,957 | 24,483 |
| Tunisia | (3) | 34,300 | 39,700 | 48,600 | 56,400 | (4) |
| Union of South Africa | 1,000,000 | 436,000 | 527,000 | 760,047 | 839,526 | (4) |
| Oceania: Australia | 1,323,000 | 417,000 | 559,000 | 656,000 | [5] 730,000 | (4) |
| | 144,020,000 | 58,250,000 | 65,370,000 | 78,460,000 | [5] 83,040,000 | (4) |

[1] Table includes all kinds of cement. Few data are available for Afghanistan, Burma, Eritrea, Ethiopia, Hong Kong, Luxemburg, Taiwan, and Venezuela, and they do not permit the establishment of production figures at this time, but estimates of production and capacity of these countries are included in the totals. The present plant capacity of China and Spain is in reality unknown owing to the destructive effects of military operations.

[2] Figures are approximate only and are subject to revision.

[3] Data not available, estimate included in total.

[4] Data not yet available.

[5] Approximate production.

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*Canada.*—According to the Dominion Bureau of Statistics, sales of portland cement by Canadian producers declined 11 percent in quantity and 9 percent in value in 1938 compared with 1937. The Canadian Cement Co., Ltd., the largest producer, operated two plants in Quebec, two in Ontario, and one each in Manitoba and Alberta. Two smaller companies also produce cement in Canada, one in Ontario and the other in British Columbia. The following table presents the principal statistics of the Canadian industry.

*Salient statistics of the cement industry in Canada, 1937–38* [1]

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Barrels | Value | Barrels | Value |
| Output | 6,142,934 | | 5,558,047 | |
| Sales: | | | | |
| Quebec | 2,578,623 | $3,537,798 | 2,730,320 | $3,693,188 |
| Ontario | 2,650,652 | 3,657,067 | 1,818,032 | 2,555,214 |
| Manitoba | 328,518 | 745,736 | 330,889 | 754,427 |
| Alberta | 267,106 | 531,541 | 304,373 | 611,790 |
| British Columbia | 344,072 | 623,725 | 335,488 | 626,731 |
| Total sales | 6,168,971 | 9,095,867 | 5,519,102 | 8,241,350 |
| Stocks, Dec. 31 | 1,806,343 | | 1,875,288 | |
| Imports: | | | | |
| Portland | 61,082 | 134,113 | 48,497 | 105,326 |
| Manufactures | | 45,744 | | 6,650 |
| Total imports | | 179,857 | | 111,976 |
| Exports | 72,568 | 82,978 | 89,419 | 101,059 |
| Apparent consumption | 6,157,485 | | 5,478,180 | |

[1] Dominion Bureau of Statistics.

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# STONE

By Oliver Bowles and M. Schauble

## SUMMARY OUTLINE


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The stone industries in 1938 failed to maintain the gains won in 1936 and 1937. Sales of both crushed and dimension stone dropped 6 percent in quantity and 5 percent in value compared with 1937. Dimension-stone sales (exclusive of slate) declined 6 percent in quantity and 10 percent in value, while crushed-stone sales (excluding that used for lime and cement manufacture) dropped 6 percent in quantity and 4 percent in value. Sales of stone depend to an unusual degree on the volume of building and highway construction. The building industries made substantial gains during the late months of 1938, with consequent stimulation of stone production, but the increase in output during that period was insufficient to overcome the decline in sales early in the year. Detailed figures of sales of stone by kinds and uses appear in following sections.

The present chapter follows the general plan of the chapter on Stone in Minerals Yearbook, 1938, data on dimension stone being separated from that on crushed stone, except in the introductory general tables.

The tables in this report give the quantities sold or used by producers and the values f. o. b. quarries and mills insofar as these figures are obtainable. Stone quarried and used by the producer is considered as sold and is included in the statistics of sales. The data, however, do not include stone made into abrasives (such as grindstones) or that used in making lime and cement. These materials are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following tables show total sales of stone by kinds, uses, and States.



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*Stone sold or used by producers in the United States, 1934-38, by kinds*

[Quantities approximate]

| Year | Granite | | Basalt and related rocks (trap rock) | | Marble | | Limestone | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 6,791,850 | $14,889,155 | 11,642,830 | $11,269,853 | 177,280 | $3,370,917 | 57,501,510 | $53,790,846 |
| 1935 | 6,013,990 | 13,507,165 | 9,671,950 | 9,315,040 | 132,450 | 3,415,861 | 57,492,760 | 50,668,765 |
| 1936 | 15,442,150 | 22,893,289 | 14,014,440 | 13,386,933 | 165,760 | 5,761,554 | 87,735,740 | 81,559,984 |
| 1937 | 9,265,830 | 20,192,882 | 13,581,460 | 12,508,276 | 207,760 | 5,456,191 | 94,577,270 | 90,901,877 |
| 1938 | 10,432,980 | 20,915,609 | 13,908,790 | 12,280,016 | 219,390 | 5,248,290 | 81,679,690 | 82,286,555 |

| Year | Sandstone | | Other stone [1] | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 3,605,420 | $4,714,284 | 12,344,940 | $10,944,881 | 92,063,830 | $98,979,936 |
| 1935 | 3,009,790 | 4,568,093 | 6,838,110 | 6,349,573 | 83,159,050 | 87,824,497 |
| 1936 | 6,254,290 | 9,717,105 | 7,804,040 | 8,207,114 | 131,416,420 | 141,525,979 |
| 1937 | 5,072,660 | 7,516,136 | 10,438,260 | 9,637,766 | 133,143,240 | 146,213,128 |
| 1938 | 6,314,430 | 8,066,200 | 12,283,660 | 10,458,376 | 124,838,940 | 139,255,046 |

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, and such other stone as cannot properly be classed in any main group.

*Stone, sold or used by producers in the United States, 1937–38, by uses*

| Use | 1937 | | 1938 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Dimension stone: | | | | |
| Building stone: | | | | |
| Rough construction, short tons | 550,740 | $1,164,921 | 463,720 | $905,536 |
| Cut stone, slabs, and mill blocks, cubic feet | 7,950,860 | 11,977,753 | 7,135,860 | 10,989,024 |
| Approximate equivalent in short tons | 608,200 | | 541,870 | |
| Rubble, short tons | 250,620 | 333,761 | 370,060 | 426,796 |
| Monumental stone, cubic feet | 3,018,210 | 8,426,623 | 2,450,930 | 7,359,184 |
| Approximate equivalent in short tons | 249,050 | | 201,680 | |
| Paving blocks, number | 7,879,944 | 781,259 | 4,300,930 | 462,729 |
| Approximate equivalent in short tons | 73,900 | | 38,220 | |
| Curbing, cubic feet | 1,219,100 | 1,139,206 | 1,375,920 | 1,217,091 |
| Approximate equivalent in short tons | 98,390 | | 109,170 | |
| Flagging, do | 627,010 | 509,014 | 488,340 | 417,802 |
| Approximate equivalent in short tons | 50,330 | | 41,400 | |
| Total dimension stone (quantities approximate, in short tons) | 1,881,230 | 24,332,537 | 1,766,120 | 21,778,162 |
| Crushed and broken stone: | | | | |
| Riprap, short tons | 5,388,920 | 5,850,101 | 6,210,520 | 6,995,418 |
| Crushed stone, do | 88,432,570 | 82,824,608 | 94,763,050 | 88,767,221 |
| Furnace flux (limestone and marble), do | 21,331,970 | 14,704,458 | 9,702,860 | 6,943,429 |
| Refractory stone [1], do | 1,525,260 | 2,258,900 | 659,690 | 991,765 |
| Agricultural (limestone), do | 5,004,930 | 6,454,695 | 4,367,410 | 5,637,485 |
| Other uses [2], do | 9,578,360 | 9,787,829 | 7,369,290 | 8,141,566 |
| Total crushed and broken stone, do | 131,262,010 | 121,880,591 | 123,072,820 | 117,476,884 |
| Grand total (quantities approximate, in short tons) | 133,143,240 | 146,213,128 | 124,838,940 | 139,255,046 |

[1] Ganister, sandstone, mica schist, soapstone, and dolomite.

[2] Includes roofing granules, as follows: 1937, 168,150 tons valued at $761,928; 1938, 171,389 tons, $666.917. There were also produced slate granules used for roofing as follows: 1937, 277,010 tons valued at $1,578,014; 1938, 349,000 tons, $2,489,962. These figures are included in the chapter on Slate in this volume.

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*Stone sold or used by noncommercial producers in the United States in 1938, by uses*

| Use | Short tons | Value | Use | Short tons | Value |
|---|---|---|---|---|---|
| Dimension stone: | | | Crushed and broken stone: | | |
| Building stone | 20,970 | $113,948 | Riprap | 2,004,570 | $3,199,288 |
| Rubble | 80,710 | 111,992 | Crushed stone | 34,508,880 | 35,785,401 |
| Curbing | 4,780 | 39,231 | Agricultural (limestone) | 423,640 | 579,331 |
| Flagging | 290 | 2,250 | Other uses | 167,810 | 168,815 |
| Total dimension stone | 106,750 | 267,421 | Total crushed and broken | 37,104,900 | 39,732,835 |
| | | | Grand total | 37,211,650 | 40,000,256 |

*Stone sold or used by producers in the United States, 1937–38, by States*

| State | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Active plants | Short tons (approximate) | Value | Active plants | Short tons (approximate) | Value |
| Alabama | 22 | [1] 1,500,860 | [1] $1,573,890 | 54 | 1,326,160 | $1,809,379 |
| Alaska | 4 | [1] 38,450 | [1] 59,845 | 12 | 189,090 | 204,232 |
| Arizona | 37 | 754,170 | 983,073 | 28 | 431,310 | 337,078 |
| Arkansas | 23 | 476,370 | 485,685 | 31 | [1] 308,760 | [1] 293,497 |
| California | 220 | 8,356,260 | 7,007,329 | 183 | 7,634,260 | 6,632,719 |
| Colorado | 60 | [1] 1,018,100 | [1] 814,930 | 71 | 897,270 | 1,051,333 |
| Connecticut | 30 | [1] 1,661,630 | [1] 1,859,648 | 32 | 1,529,730 | 1,731,707 |
| Delaware | 2 | [2] | [2] | 2 | [2] | [2] |
| District of Columbia | 2 | [2] | [2] | 1 | [2] | [2] |
| Florida | 38 | 1,600,380 | 1,408,749 | 39 | [1] 1,349,160 | [1] 1,223,438 |
| Georgia | 73 | 1,737,760 | 3,597,039 | 89 | 1,465,680 | 3,581,319 |
| Hawaii | 19 | [1] 633,430 | [1] 948,113 | 17 | 515,140 | 727,194 |
| Idaho | 24 | 891,270 | 700,627 | 39 | 1,047,980 | 795,896 |
| Illinois | 260 | [1] 9,887,260 | [1] 8,383,931 | 250 | [1] 8,528,440 | [1] 7,335,844 |
| Indiana | 145 | [1] 3,504,530 | [1] 6,397,891 | 213 | [1] 3,782,410 | [1] 6,486,996 |
| Iowa | 221 | 4,294,310 | 4,276,891 | 228 | 3,369,750 | 3,782,480 |
| Kansas | 499 | [1] 3,540,860 | [1] 4,763,080 | 237 | [1] 3,676,230 | [1] 4,958,723 |
| Kentucky | 118 | [1] 3,433,190 | [1] 3,040,322 | 134 | [1] 3,361,600 | [1] 2,987,494 |
| Louisiana | 2 | [2] | [2] | 1 | [2] | [2] |
| Maine | 43 | [1] 265,340 | [1] 1,546,037 | 35 | 192,250 | 1,161,535 |
| Maryland | 51 | [1] 836,800 | [1] 1,139,767 | 46 | [1] 947,390 | [1] 1,167,518 |
| Massachusetts | 60 | [1] 2,353,500 | [1] 4,408,297 | 67 | [1] 2,188,820 | [1] 3,865,042 |
| Michigan | 35 | [1] 12,347,790 | [1] 6,553,610 | 43 | [1] 7,900,370 | [1] 4,059,590 |
| Minnesota | 103 | [1] 822,680 | [1] 1,991,199 | 126 | 941,050 | 1,914,056 |
| Mississippi | 1 | [2] | [2] | | | |
| Missouri | 215 | [1] 3,635,250 | [1] 4,742,459 | 294 | 3,332,480 | 4,458,781 |
| Montana | 30 | [1] 340,450 | [1] 439,785 | 38 | 1,364,680 | 1,717,417 |
| Nebraska | 23 | 763,710 | 1,146,335 | 24 | [1] 510,240 | [1] 780,664 |
| Nevada | 8 | [1] 76,340 | [1] 66,217 | 12 | 344,760 | 246,319 |
| New Hampshire | 22 | 71,090 | 442,772 | 20 | 53,790 | 444,537 |
| New Jersey | 39 | [1] 2,379,590 | [1] 2,621,038 | 35 | 2,583,220 | 2,678,766 |
| New Mexico | 23 | 713,500 | 302,723 | 14 | [1] 698,350 | [1] 438,284 |
| New York | 291 | 10,882,980 | 11,244,495 | 247 | 10,061,250 | 10,527,452 |
| North Carolina | 122 | 2,624,770 | 3,314,634 | 145 | [1] 4,552,120 | [1] 5,789,486 |
| North Dakota | 3 | 44,570 | 15,012 | 8 | 20,090 | 5,395 |
| Ohio | 184 | 10,306,140 | 9,426,808 | 221 | [1] 9,888,730 | [1] 8,970,552 |
| Oklahoma | 57 | 1,098,790 | 1,149,624 | 78 | [1] 1,101,320 | [1] 1,338,858 |
| Oregon | 101 | [1] 2,010,490 | [1] 1,442,916 | 142 | [1] 2,355,970 | [1] 2,025,335 |
| Pennsylvania | 317 | 16,091,160 | 17,251,160 | 362 | 12,134,290 | 13,045,423 |
| Puerto Rico | 14 | [1] 166,150 | [1] 182,109 | 43 | [1] 239,610 | [1] 247,896 |
| Rhode Island | 13 | [1] 113,990 | [1] 477,729 | 16 | [1] 262,910 | [1] 601,355 |
| South Carolina | 21 | 936,880 | 1,462,738 | 16 | [1] 987,280 | [1] 1,315,999 |
| South Dakota | 52 | [1] 407,270 | [1] 982,906 | 93 | 320,740 | 899,190 |
| Tennessee | 115 | [1] 2,720,750 | [1] 3,979,159 | 149 | [1] 2,599,840 | [1] 4,237,351 |
| Texas | 82 | [1] 2,149,320 | [1] 2,218,643 | 96 | 3,256,240 | 2,625,281 |
| Utah | 23 | 453,540 | 315,985 | 26 | [1] 709,430 | [1] 390,249 |
| Vermont | 34 | [1] 194,770 | [1] 4,215,766 | 80 | 264,480 | 3,148,950 |
| Virginia | 162 | [1] 5,061,660 | [1] 5,399,137 | 191 | 5,474,690 | 5,606,470 |
| Washington | 77 | 2,027,420 | 1,909,604 | 116 | [1] 2,321,210 | [1] 1,849,051 |
| West Virginia | 168 | [1] 3,510,040 | [1] 3,696,556 | 243 | [1] 3,194,980 | [1] 4,391,563 |
| Wisconsin | 205 | 3,331,670 | 4,284,003 | 207 | 3,097,230 | 3,880,935 |
| Wyoming | 14 | [1] 342,710 | [1] 287,957 | 11 | 252,170 | 346,018 |
| Undistributed | | 733,300 | 1,254,905 | | 1,273,990 | 1,140,399 |
| | 4,507 | 133,143,240 | 146,213,128 | 4,905 | 124,838,940 | 139,255,046 |

[1] To avoid disclosing confidential information certain State totals are slightly incomplete, the figures not included being combined under "Undistributed."
[2] Included under "Undistributed."

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If sales in 1938 are compared with those in 1937 declines in all branches of the dimension-stone industries except rubble and curbing are evident. Sales of both crushed stone and riprap were considerably larger in 1938 than in 1937, but the output of furnace flux and refractory stone fell to unusually low levels.

## DIMENSION STONE

Total sales of dimension stone in 1938 declined 7 percent in quantity and 12 percent in value from 1937. These figures include slate, but details of the slate industry are given in a separate chapter of this volume. Sales of all varieties except miscellaneous stone were lower than in 1937; the latter, however, made a substantial gain in quantity but suffered a loss in value.

The following table of salient statistics includes final figures for both 1937 and 1938 and the percentage of change from 1937 for each type of stone by principal products.

*Dimension stone sold or used by producers in the United States, 1937–38, by kinds and uses*

| Kind and use | 1937 | 1938 | |
|---|---|---|---|
| | | Total | Percent of change |
| Granite: | | | |
| Building stone: | | | |
| Rough construction, short tons | 172,480 | 202,640 | +17.5 |
| Value | $386,267 | $343,984 | −10.9 |
| Average per ton | $2.24 | $1.70 | −24.1 |
| Cut stone, slabs, and mill blocks, cubic feet | 1,240,040 | 967,410 | −22.0 |
| Value | $2,681,888 | $2,460,649 | −8.2 |
| Average per cubic foot | $2.16 | $2.54 | +17.6 |
| Rubble, short tons | 111,140 | 108,220 | −2.6 |
| Value | $149,958 | $127,372 | −15.1 |
| Monumental stone, cubic feet | 2,657,630 | 2,092,540 | −21.3 |
| Value | $6,628,447 | $5,650,996 | −14.7 |
| Average per cubic foot | $2.49 | $2.70 | +8.4 |
| Paving blocks, number | 7,866,994 | 4,165,230 | −47.1 |
| Value | $780,611 | $452,542 | −42.0 |
| Curbing, cubic feet | 881,310 | 894,970 | +1.5 |
| Value | $825,148 | $742,489 | −10.0 |
| Total: | | | |
| Quantity, approximate short tons | 751,330 | 672,630 | −10.5 |
| Value | $11,452,319 | $9,778,032 | −14.6 |
| Basalt and related rocks (trap rock): | | | |
| Building stone: | | | |
| Rough construction, short tons | 16,170 | 7,970 | −50.7 |
| Value | $21,482 | $11,654 | −45.7 |
| Average per ton | $1.33 | $1.46 | +9.8 |
| Rubble, short tons | 8,930 | 13,880 | +55.4 |
| Value | $6,478 | $9,897 | +52.8 |
| Total: | | | |
| Quantity, short tons | 25,100 | 21,850 | −12.9 |
| Value | $27,960 | $21,551 | −22.9 |
| Marble: | | | |
| Building stone (cut stone, slabs, and mill blocks), cubic feet | 731,700 | 687,290 | −6.1 |
| Value | $3,336,545 | $3,264,877 | −2.1 |
| Average per cubic foot | $4.56 | $4.75 | +4.2 |
| Monumental stone, cubic feet | 360,580 | 358,390 | −0.6 |
| Value | $1,798,176 | $1,708,188 | −5.0 |
| Average per cubic foot | $4.99 | $4.77 | −4.4 |
| Total: | | | |
| Quantity, approximate short tons | 95,460 | 89,000 | −6.8 |
| Value | $5,134,721 | $4,473,065 | −3.1 |

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*Dimension stone sold or used by producers in the United States, 1937–38, by kinds and uses*—Continued

| Kind and use | 1937 | 1938 | |
|---|---|---|---|
| | | Total | Percent of change |
| Limestone: | | | |
| Building stone: | | | |
| Rough construction, short tons | 191,660 | 166,260 | −13.3 |
| Value | $380,324 | $316,772 | −16.7 |
| Average per ton | $1.98 | $1.91 | −3.5 |
| Cut stone, slabs, and mill blocks, cubic feet | 5,455,050 | 5,077,950 | −6.9 |
| Value | $4,716,211 | $4,350,724 | −7.7 |
| Average per cubic foot | $0.86 | $0.86 | |
| Rubble, short tons | 107,550 | 155,370 | +44.5 |
| Value | $136,028 | $194,621 | +43.1 |
| Flagging, cubic feet | 167,950 | 95,880 | −42.9 |
| Value | $76,806 | $74,560 | −2.9 |
| Total: | | | |
| Quantity, approximate short tons | 713,580 | 704,080 | −1.3 |
| Value | $5,309,369 | $4,936,677 | −7.0 |
| Sandstone: | | | |
| Building stone: | | | |
| Rough construction, short tons | 113,880 | 64,290 | −43.5 |
| Value | $294,657 | $190,419 | −35.4 |
| Average per ton | $2.59 | $2.96 | +14.3 |
| Cut stone, slabs, and mill blocks, cubic feet | 455,120 | 332,530 | −26.9 |
| Value | $650,295 | $440,444 | −32.3 |
| Average per cubic foot | $1.43 | $1.32 | −7.7 |
| Rubble, short tons | 22,700 | 10,990 | −51.6 |
| Value | $41,297 | $23,703 | −42.6 |
| Paving blocks, number | 12,950 | 135,700 | +947.9 |
| Value | $648 | $10,187 | +1,472.1 |
| Curbing, cubic feet | 337,790 | 480,950 | +42.4 |
| Value | $314,058 | $474,602 | +51.1 |
| Flagging, cubic feet | 445,280 | 372,050 | −16.4 |
| Value | $419,788 | $334,322 | −20.4 |
| Total: | | | |
| Quantity, approximate short tons | 231,630 | 166,120 | −28.3 |
| Value | $1,720,743 | $1,473,677 | −14.4 |
| Miscellaneous stone: [1] | | | |
| Building stone, cubic feet | 739,750 | 332,700 | −55.0 |
| Value | $675,005 | $515,037 | −23.7 |
| Average per cubic foot | $0.91 | $1.55 | +70.3 |
| Rubble, short tons | | 81,600 | |
| Value | | $71,203 | |
| Flagging, cubic feet | 13,780 | 20,410 | +48.1 |
| Value | $12,420 | $8,920 | −28.2 |
| Total: | | | |
| Quantity, approximate short tons | 64,130 | 112,440 | +75.3 |
| Value | $687,425 | $595,160 | −13.4 |
| Total, exclusive of slate: | | | |
| Quantity, approximate short tons | 1,881,230 | 1,766,120 | −6.1 |
| Value | $24,332,537 | $21,778,162 | −10.5 |
| Slate as dimension stone [2], approximate short tons | 167,550 | 143,690 | −14.2 |
| Value | $4,027,308 | $3,165,351 | −21.4 |
| Total, including slate: | | | |
| Quantity, approximate short tons | 2,048,780 | 1,909,810 | −6.8 |
| Value | $28,359,845 | $24,943,513 | −12.0 |

[1] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.
[2] Details of production, by uses, are given in the chapter on Slate in this volume.

## BUILDING STONE

The largest use of dimension stone is for building. The following table gives the quantity and value of each kind of stone used for construction in 1937 and 1938.

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*Building stone sold or used by producers in the United States in 1938, by kinds*

| Kind | Rough | | | |
|---|---|---|---|---|
| | Construction | | Architectural | |
| | Cubic feet | Value | Cubic feet | Value |
| Granite | 2,449,520 | $343,984 | 311,570 | $238,820 |
| Basalt | 94,470 | 11,654 | | |
| Marble | | | 159,530 | 376,400 |
| Limestone | 2,006,460 | 316,772 | 2,455,580 | 895,791 |
| Sandstone | 829,450 | 190,419 | 64,100 | 42,389 |
| Miscellaneous | 262,020 | 42,707 | | |
| | 5,641,920 | 905,536 | 2,990,780 | 1,553,400 |

| Kind | Finished | | | | Total | |
|---|---|---|---|---|---|---|
| | Sawed [1] | | Cut [1] | | | |
| | Cubic feet | Value | Cubic feet | Value | Cubic feet | Value |
| Granite | 351,210 | $719,730 | 304,630 | $1,502,099 | 3,416,930 | $2,304,633 |
| Basalt | | | | | 94,470 | 11,654 |
| Marble | 149,650 | 423,977 | 378,110 | 2,464,500 | 687,290 | 3,264,877 |
| Limestone | 1,030,350 | 654,515 | 1,592,020 | 2,800,418 | 7,084,410 | 4,667,496 |
| Sandstone | 188,650 | 224,690 | 79,780 | 173,365 | 1,161,980 | 630,863 |
| Miscellaneous | | | 70,680 | 472,330 | 332,700 | 515,037 |
| | 1,719,860 | 2,022,912 | 2,425,220 | 7,412,712 | 12,777,780 | 11,894,560 |

[1] For granite, sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

## GRANITE

Sales of all granite products receded in 1938 both in quantity and value except rough construction stone and curbing, both of which gained in quantity but declined in value. The following table shows production by States and uses in 1938.

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*Granite (dimension stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Building | | | | | | | | Monumental | | | | Paving blocks | | Curbing | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Rough | | | | Dressed | | Rubble | | Rough | | Dressed | | | | | | | |
| | | Construction | | Architectural | | | | | | | | | | | | | | | |
| | | Short tons | Value | Cubic feet | Value | Cubic feet | Value | Short tons | Value | Cubic feet | Value | Cubic feet | Value | Number | Value | Cubic feet | Value | Short tons (approximate) | Value |
| California | 14 | 740 | $1,381 | 1,860 | $3,255 | ------ | ------ | 2,960 | $1,184 | 11,620 | $22,139 | 4,360 | $18,676 | ------ | ------ | 3,800 | $5,139 | 5,460 | $51,774 |
| Colorado | 9 | ------ | ------ | (1) | (1) | ------ | ------ | ------ | ------ | 2,300 | 4,534 | 2,950 | 13,377 | ------ | ------ | ------ | ------ | (1) | (1) |
| Connecticut | 10 | 6,320 | 22,517 | 2,580 | 2,587 | (1) | (1) | (1) | (1) | 4,820 | 19,924 | (1) | (1) | 1,000 | $236 | 18,590 | 22,115 | 13,480 | 164,094 |
| Delaware | 1 | ------ | ------ | ------ | ------ | ------ | ------ | (1) | (1) | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | (1) | (1) |
| Georgia | 20 | 12,300 | 10,784 | (1) | (1) | 25,180 | $62,351 | 27,440 | 19,551 | 518,750 | 544,371 | 64,440 | 307,155 | (1) | (1) | 101,510 | 65,200 | 100,510 | 1,021,939 |
| Maine | 19 | 5,290 | 12,934 | 62,300 | 45,824 | 170,870 | 487,658 | 5,740 | 5,875 | 9,810 | 12,093 | 3,730 | 10,424 | 3,009,930 | 341,787 | 24,780 | 14,869 | 59,420 | 931,464 |
| Maryland | 7 | 94,130 | 150,992 | 3,000 | 5,186 | 7,850 | 20,754 | 2,430 | 3,032 | ------ | ------ | ------ | ------ | ------ | ------ | 6,270 | 1,571 | 97,960 | 181,535 |
| Massachusetts | 24 | 9,590 | 8,042 | 23,140 | 23,844 | 281,740 | 831,380 | (1) | (1) | 27,710 | 59,459 | (1) | (1) | 332,740 | 28,029 | 533,090 | 491,303 | 113,180 | 1,575,832 |
| Minnesota | 28 | ------ | ------ | 130,730 | 70,489 | 14,820 | 70,294 | ------ | ------ | 196,100 | 192,835 | 60,440 | 379,285 | ------ | ------ | ------ | ------ | 33,380 | 712,903 |
| Missouri | 4 | 830 | 1,627 | 1,500 | 3,000 | ------ | ------ | ------ | ------ | 8,830 | 15,720 | 1,800 | 6,500 | ------ | ------ | ------ | ------ | 1,850 | 26,847 |
| Montana | 8 | ------ | ------ | 210 | 213 | 200 | 580 | ------ | ------ | 1,820 | 3,463 | 480 | 3,685 | ------ | ------ | ------ | ------ | 230 | 7,941 |
| New Hampshire | 12 | 3,340 | 1,840 | 16,330 | 12,144 | 57,290 | 297,569 | (1) | (1) | 5,500 | 10,262 | (1) | (1) | 58,050 | 3,339 | 7,670 | 9,011 | 19,090 | 382,822 |
| New Jersey | 1 | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | (1) | (1) |
| New York | 4 | 3,700 | 20,875 | 1,300 | 9,100 | 2,870 | 17,236 | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) | (1) | (1) | 8,690 | 55,409 |
| North Carolina | 10 | 7,800 | 22,659 | 2,290 | 1,887 | 41,330 | 210,335 | 1,600 | 3,527 | 30,090 | 44,289 | 7,260 | 62,928 | 18,000 | 982 | 188,020 | 125,633 | 31,260 | 472,240 |
| Oklahoma | 7 | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) | 54,290 | 167,989 | 12,030 | 110,178 | ------ | ------ | (1) | (1) | 6,140 | 279,005 |
| Oregon | 2 | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) |
| Pennsylvania | 13 | 54,860 | 83,794 | 1,920 | 7,765 | (1) | (1) | 15,740 | 16,408 | (1) | (1) | 22,120 | 93,686 | (1) | (1) | 2,530 | 1,218 | 73,860 | 226,125 |
| Rhode Island | 4 | (1) | (1) | ------ | ------ | ------ | ------ | 6,140 | 4,906 | 38,230 | 148,183 | (1) | (1) | ------ | ------ | ------ | ------ | 10,330 | 211,062 |
| South Carolina | 5 | ------ | ------ | (1) | (1) | ------ | ------ | (1) | (1) | (1) | (1) | (1) | (1) | ------ | ------ | (1) | (1) | 12,190 | 165,133 |
| South Dakota | 8 | ------ | ------ | 12,990 | 7,202 | (1) | (1) | ------ | ------ | (1) | (1) | 68,060 | 520,545 | ------ | ------ | ------ | ------ | 11,990 | 568,426 |
| Texas | 6 | (1) | (1) | (1) | (1) | ------ | ------ | (1) | (1) | 20,410 | 28,672 | (1) | (1) | ------ | ------ | (1) | (1) | 4,460 | 44,477 |
| Vermont | 13 | ------ | ------ | (1) | (1) | (1) | (1) | ------ | ------ | 605,790 | 1,849,890 | (1) | (1) | ------ | ------ | ------ | ------ | 50,130 | 1,909,895 |
| Virginia | 2 | (1) | (1) | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) | ------ | ------ | (1) | (1) | (1) | (1) | (1) | (1) |
| Washington | 3 | ------ | ------ | ------ | ------ | 130 | 1,131 | ------ | ------ | 380 | 673 | 2,200 | 26,134 | ------ | ------ | ------ | ------ | 220 | 27,938 |
| Wisconsin | 17 | (1) | (1) | (1) | (1) | 7,970 | 77,754 | 2,010 | 2,012 | 12,180 | 23,489 | 43,850 | 515,438 | (1) | (1) | ------ | ------ | 12,210 | 688,641 |
| Undistributed | ------ | 3,740 | 6,539 | 51,420 | 46,324 | 45,590 | 144,787 | 44,160 | 70,877 | 212,560 | 197,804 | 37,630 | 237,196 | 745,510 | 78,169 | 8,710 | 6,430 | 6,590 | 72,530 |
| | 251 | 202,640 | 343,984 | 311,570 | 238,820 | 655,840 | 2,221,829 | 108,220 | 127,372 | 1,761,190 | 3,345,789 | 331,350 | 2,305,207 | 4,165,230 | 452,542 | 894,970 | 742,489 | 672,630 | 9,778,032 |
| Short tons (approximate) | ------ | (2) | ------ | 25,990 | ------ | 54,220 | ------ | ------ | ------ | 145,060 | ------ | 26,250 | ------ | 36,890 | ------ | 73,360 | ------ | ------ | ------ |

[1] Included under "Undistributed."

[2] 2,449,520 cubic feet (approximate).

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The following tables show sales of monumental granite in the important Quincy (Mass.) and Barre (Vt.) centers.

*Monumental granite sold by the quarrymen at Quincy, Mass., 1934–38* [1]

| Year | Active plants | Cubic feet | Value | Year | Active plants | Cubic feet | Value |
|---|---|---|---|---|---|---|---|
| 1934 | 3 | 56,290 | $100,879 | 1937 | 3 | 36,020 | $80,248 |
| 1935 | 3 | 63,450 | 95,529 | 1938 | 3 | 33,360 | 73,832 |
| 1936 | 3 | 46,570 | 85,013 | | | | |

[1] Quincy granite is sold also for construction, curbing, rubble, riprap, and crushed stone.

*Monumental granite sold by the quarrymen in the Barre district, Vermont, 1934–38* [1]

| Year | Cubic feet | Value | Year | Cubic feet | Value |
|---|---|---|---|---|---|
| 1934 | 709,820 | $1,878,644 | 1937 | 847,740 | $2,390,377 |
| 1935 | 676,820 | 1,844,006 | 1938 | 605,660 | 1,849,607 |
| 1936 | 771,230 | 2,109,526 | | | |

[1] Barre granite is sold also for construction, paving blocks, and crushed stone.

*Estimated output of monumental granite in Barre district, Vermont, 1935–37* [1]

| | 1935 | 1936 | 1937 |
|---|---|---|---|
| Total quarry output, rough stock, cubic feet | 668,838 | 775,626 | 765,390 |
| Shipped out of Barre district in rough, do | 133,768 | 155,125 | 153,078 |
| Manufactured in Barre district, do | 535,070 | 620,501 | 612,312 |
| Light stock consumed in district, do | 418,024 | 484,766 | 478,369 |
| Dark stock consumed in district, do | 250,814 | 290,860 | 287,021 |
| Number of cutters in district | 1,240 | 1,550 | 1,550 |
| Average daily wage | $8.00 | $8.00 | $8.00 |
| Average number of days worked | 225 | 230 | 230 |
| Total pay roll for year | $2,232,000 | $2,852,000 | $2,852,000 |
| Estimated overhead | 1,116,000 | 1,426,000 | 1,426,000 |
| Estimated value of light stock | 1,358,577 | 1,575,490 | 1,554,699 |
| Estimated value of dark stock | 1,003,257 | 1,163,440 | 1,234,191 |
| Estimated polishing cost | 423,174 | 490,739 | 484,263 |
| Output from saws | 141,058 | 163,580 | 161,421 |
| Total value of granite | 6,274,066 | 7,671,249 | 7,712,574 |

[1] Through the kindness of the Granite Manufacturers' Association, Barre, figures covering the entire granite industry of the Barre district are given in this table to supplement figures of sales reported by quarrymen; figures for 1938 not yet available.

## BASALT AND RELATED ROCKS (TRAP ROCK)

Because of its dark color basalt is not used extensively for building. As the table of salient statistics indicates, sales for building were only about half as great in 1938 as in 1937. Sales of rubble, however, made substantial gains. The following table shows production by States in 1938.

Basalt and related rocks are used for memorials, but such stones are classed commercially as black granites, therefore they are included with the figures for monumental granite.

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*Basalt and related rocks (trap rock) (dimension stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Building stone | | | | Total | |
|---|---|---|---|---|---|---|---|
| | | Rough construction | | Rubble | | | |
| | | Short tons | Value | Short tons | Value | Short tons | Value |
| California | 2 | | | (1) | (1) | (1) | (1) |
| Connecticut | 2 | (1) | (1) | | | (1) | (1) |
| Massachusetts | 1 | | | 540 | $268 | 540 | $268 |
| New Jersey | 1 | 80 | $82 | | | 80 | 82 |
| Oregon | 3 | 1,290 | 3,668 | | | 1,290 | 3,668 |
| Pennsylvania | 3 | (1) | (1) | (1) | (1) | 3,190 | 5,483 |
| Virginia | 2 | (1) | (1) | (1) | (1) | (1) | (1) |
| Undistributed | | 6,600 | 7,904 | 13,340 | 9,629 | 16,750 | 12,050 |
| | 14 | [2] 7,970 | 11,654 | 13,880 | 9,897 | 21,850 | 21,551 |

[1] Included under "Undistributed." [2] 94,470 cubic feet (approximate).

## MARBLE

Sales of marble in 1938 dropped 7 percent in quantity and 3 percent in value. The decline would have been much greater were it not for the large gains by Tennessee which supplied exterior marble for the National Gallery of Art in Washington, D. C.

*Marble sold by producers in the United States, 1937–38, by uses*

| Use | | 1937 | | 1938 | |
|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value |
| Building stone: | | | | | |
| Rough: | | | | | |
| Exterior | cubic feet | 25,100 | $36,925 | 13,880 | $24,424 |
| Interior | do | 155,620 | 484,956 | 145,650 | 351,976 |
| Finished: | | | | | |
| Exterior | do | 259,400 | 901,645 | 258,030 | 1,183,841 |
| Interior | do | 291,580 | 1,913,019 | 269,730 | 1,704,636 |
| Total exterior | do | 284,500 | 938,570 | 271,910 | 1,208,265 |
| Total interior | do | 447,200 | 2,397,975 | 415,380 | 2,056,612 |
| Total building stone | do | 731,700 | 3,336,545 | 687,290 | 3,264,877 |
| Monumental stone: | | | | | |
| Rough | do | 76,090 | 91,560 | 69,850 | 85,181 |
| Finished | do | 284,490 | 1,706,616 | 288,540 | 1,623,007 |
| Total monumental stone | do | 360,580 | 1,798,176 | 358,390 | 1,708,188 |
| Total building and monumental | do | 1,092,280 | 5,134,721 | 1,045,680 | 4,973,065 |
| | approximate short tons | 95,460 | | 89,000 | |



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*Marble (dimension stone) sold by producers in the United States in 1938, by States and uses*

| State | Active plants | Building [1] | | Monumental | | Total | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Quantity | | |
| | | Cubic feet | Value | Cubic feet | Value | Cubic feet | Short tons (approximate) | Value |
| Alabama | 3 | 29,060 | $213,816 | 36,170 | $153,946 | 65,230 | 5,540 | $367,762 |
| Alaska | 1 | (2) | (2) | | | (2) | (2) | (2) |
| Arkansas | 4 | 8,270 | 11,288 | | | 8,270 | 700 | 11,288 |
| Colorado | 1 | (2) | (2) | (2) | (2) | (2) | (2) | (2) |
| Georgia | 1 | 47,400 | 351,819 | 151,180 | 679,302 | 198,580 | 16,880 | 1,031,121 |
| Maryland | 1 | 5,810 | 48,425 | | | 5,810 | 500 | 48,425 |
| Massachusetts | 2 | 18,470 | 38,966 | 2,250 | 16,704 | 20,720 | 2,740 | 55,670 |
| Minnesota | 1 | (2) | (2) | | | (2) | (2) | (2) |
| Missouri | 4 | 131,780 | 356,285 | 8,450 | 18,831 | 140,230 | 11,170 | 375,116 |
| New York | 2 | (2) | (2) | (2) | (2) | (2) | (2) | (2) |
| North Carolina | 1 | (2) | (2) | (2) | (2) | (2) | (2) | (2) |
| Tennessee | 7 | 330,170 | 1,725,809 | 12,440 | 54,152 | 342,610 | 29,130 | 1,779,961 |
| Vermont | 6 | 74,000 | 297,384 | 138,080 | 705,997 | 212,080 | 17,950 | 1,003,381 |
| Wisconsin | 1 | (2) | (2) | | | (2) | (2) | (2) |
| Undistributed | ------- | 42,330 | 221,085 | 9,820 | 79,256 | 52,150 | 4,390 | 300,341 |
| | 35 | 687,290 | 3,264,877 | 358,390 | 1,708,188 | 1,045,680 | 89,000 | 4,973,065 |
| Short tons (approximate) | ------- | 58,630 | ---------- | 30,370 | ---------- | ---------- | ------- | ---------- |

[1] Includes 16,680 cubic feet of serpentine marble (verde antique) valued at $132,761, which was sold as building and ornamental stone.
[2] Included under "Undistributed."

## LIMESTONE

Limestone is used more extensively than any other type of building stone in the United States, and Indiana supplied 82 percent of the total architectural limestone (rough and finished) sold in 1938. Sales of cut stone, slabs, and mill blocks, which comprise the major products of the industry, decreased 7 percent in quantity and 8 percent in value in 1938 compared with 1937. The average price per cubic foot was 86 cents, the same as in 1937. Sales of stone for rough construction and for flagging declined greatly, but those of rubble made substantial gains.

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*Limestone (dimension stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Building | | | | | | | | Flagging | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Rough construction | | Rough architectural | | Finished (cut and sawed) | | Rubble | | | | | |
| | | Short tons | Value | Cubic feet | Value | Cubic feet | Value | Short tons | Value | Cubic feet | Value | Short tons (approximate) | Value |
| Alabama | 1 | | | (1) | (1) | (1) | (1) | | | | | (1) | (1) |
| California | 7 | 1,370 | $3,991 | (1) | (1) | | | 900 | $726 | (1) | (1) | 2,320 | $7,178 |
| Colorado | 3 | | | 8,600 | $15,604 | | | | | | | 690 | 15,604 |
| Florida | 6 | 9,080 | 5,216 | (1) | (1) | (1) | (1) | | | 17,800 | $25,454 | 14,780 | 114,054 |
| Georgia | 1 | (1) | (1) | | | | | | | | | (1) | (1) |
| Illinois | 7 | (1) | (1) | | | | | 4,160 | 7,471 | (1) | (1) | 47,360 | 64,714 |
| Indiana | 21 | (1) | (1) | 2,691,400 | 621,751 | 2,061,800 | $2,605,983 | 2,650 | 2,062 | (1) | (1) | 303,950 | 3,231,421 |
| Iowa | 5 | 2,410 | 1,935 | | | | | (1) | (1) | (1) | (1) | 3,240 | 3,007 |
| Kansas | 8 | 24,300 | 44,750 | (1) | (1) | | | 37,120 | 45,231 | (1) | (1) | 62,820 | 96,231 |
| Kentucky | 10 | 12,500 | 8,845 | 9,420 | 12,000 | (1) | (1) | 6,090 | 2,357 | (1) | (1) | 19,680 | 27,259 |
| Maryland | 4 | (1) | (1) | | | | | (1) | (1) | | | 1,570 | 5,299 |
| Michigan | 2 | (1) | (1) | | | | | | | | | (1) | (1) |
| Minnesota | 8 | (1) | (1) | 58,400 | 38,723 | (1) | (1) | 9,770 | 15,981 | (1) | (1) | 21,320 | 255,091 |
| Missouri | 17 | 3,870 | 5,700 | | | (1) | (1) | 33,680 | 54,679 | (1) | (1) | 38,700 | 76,606 |
| Montana | 1 | | | (1) | (1) | | | | | | | (1) | (1) |
| Nebraska | 2 | (1) | (1) | | | | | | | | | (1) | (1) |
| New York | 2 | (1) | (1) | | | | | (1) | (1) | | | (1) | (1) |
| Ohio | 15 | 11,720 | 16,352 | | | | | (1) | (1) | (1) | (1) | 13,330 | 17,664 |
| Oklahoma | 1 | | | | | | | (1) | (1) | | | (1) | (1) |
| Pennsylvania | 22 | 14,750 | 15,007 | | | | | 12,580 | 12,268 | 4,940 | 1,130 | 27,740 | 28,405 |
| South Dakota | 1 | | | | | | | 1,500 | 1,799 | | | 1,500 | 1,799 |
| Tennessee | 1 | | | | | | | (1) | (1) | | | (1) | (1) |
| Texas | 4 | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | 29,150 | 328,374 |
| Vermont | 1 | | | | | | | (1) | (1) | | | (1) | (1) |
| Virginia | 1 | | | | | | | (1) | (1) | | | (1) | (1) |
| Wisconsin | 19 | 28,210 | 124,046 | (1) | (1) | 73,840 | 83,606 | 35,840 | 41,495 | (1) | (1) | 79,550 | 322,250 |
| Wyoming | 1 | | | (1) | (1) | | | | | | | (1) | (1) |
| Undistributed | | 58,050 | 90,930 | 287,760 | 207,713 | 486,730 | 765,344 | 11,080 | 10,552 | 73,140 | 47,976 | 36,380 | 341,721 |
| | 171 | 166,260 | 316,772 | 2,455,580 | 895,791 | 2,622,370 | 3,454,933 | 155,370 | 194,621 | 95,880 | 74,560 | 704,080 | 4,936,677 |
| Short tons (approximate) | | (2) | | 179,740 | | 192,710 | | | | 10,000 | | | |

[1] Included under "Undistributed."

[2] 2,006,460 cubic feet (approximate).

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The following tables show detailed figures by uses for limestone produced near Bedford and Bloomington, Ind.; Carthage, Mo.; and Mankato and Kasota, Minn.

*Limestone sold by producers in the Indiana oolitic-limestone district, 1934–38, by classes*

| Year | Construction | | | | | |
|---|---|---|---|---|---|---|
| | Rough block | | Sawed and semifinished | | Cut | |
| | Cubic feet | Value | Cubic feet | Value | Cubic feet | Value |
| 1934 | 1,226,420 | $447,299 | 445,440 | $342,997 | 1,123,650 | $1,896,886 |
| 1935 | 1,585,150 | 423,741 | 591,850 | 359,942 | 587,870 | 963,562 |
| 1936 | 2,346,380 | 698,231 | 1,028,740 | 577,368 | 1,456,190 | 1,861,947 |
| 1937 | 2,152,560 | 727,425 | 957,240 | 633,350 | 1,332,330 | 2,168,229 |
| 1938 | 2,090,110 | 619,602 | 914,180 | 561,767 | 1,147,620 | 2,044,216 |

| Year | Construction—Continued | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|
| | Total | | | | | | |
| | Cubic feet | Short tons (approximate) | Value | Short tons | Value | Short tons | Value |
| 1934 | 2,795,510 | 203,000 | $2,687,182 | 183,510 | $94,611 | 386,510 | $2,781,793 |
| 1935 | 2,764,870 | 207,000 | 1,747,245 | 160,000 | 107,000 | 367,000 | 1,854,245 |
| 1936 | 4,831,310 | 350,270 | 3,137,546 | 178,150 | 132,898 | 528,420 | 3,270,444 |
| 1937 | 4,442,130 | 322,050 | 3,529,004 | 139,250 | 68,253 | 461,300 | 3,597,257 |
| 1938 | 4,151,910 | 310,000 | 3,225,585 | 41,610 | 26,595 | 351,610 | 3,252,180 |

*Indiana limestone sold by mills in the district not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1934–38, by classes*

| Year | Sawed and semi-finished | | Cut | | Total | |
|---|---|---|---|---|---|---|
| | Cubic feet | Value | Cubic feet | Value | Cubic feet | Value |
| 1934 | 58,940 | $75,384 | 589,810 | $1,056,293 | 648,750 | $1,131,677 |
| 1935 | 59,950 | 23,209 | 536,680 | 832,412 | 596,630 | 855,621 |
| 1936 | 461,560 | 328,015 | 1,392,150 | 1,956,641 | 1,853,710 | 2,284,656 |
| 1937 | 168,340 | 93,815 | 1,142,249 | 1,931,488 | 1,310,589 | 2,025,303 |
| 1938: | | | | | | |
| Mills not operated by quarry companies | 33,680 | 15,274 | 508,700 | 811,416 | 542,380 | 826,690 |
| Mills of quarry companies from stock obtained at quarries other than their own | 76,990 | 54,622 | 627,710 | 891,838 | 704,700 | 946,460 |
| | 110,670 | 69,896 | 1,136,410 | 1,703,254 | 1,247,080 | 1,773,150 |

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*Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1934–38, by classes*

| Year | Dimension stone (rough and dressed) | | | | | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Building | | Monumental | | Total | | | | | | |
| | Cubic feet | Value | Cubic feet | Value | Cubic feet | Short tons (approximate) | Value | Short tons | Value | Short tons | Value |
| 1934 | 33,020 | $81,555 | 6,110 | $10,722 | 39,130 | 3,260 | $92,277 | 41,090 | $39,159 | 44,350 | $131,436 |
| 1935 | 71,930 | 142,507 | 2,620 | 9,246 | 74,550 | 6,220 | 151,753 | 46,470 | 66,211 | 52,690 | 217,964 |
| 1936 | 116,970 | 296,653 | 5,500 | 10,998 | 122,470 | 10,220 | 307,651 | 69,370 | 109,028 | 79,590 | 416,679 |
| 1937 | 128,570 | 338,040 | 7,530 | 14,912 | 136,100 | 11,380 | 352,952 | 95,840 | 128,617 | 107,220 | 481,569 |
| 1938 | 113,940 | 300,936 | 8,450 | 18,831 | 122,390 | 10,220 | 319,767 | 65,560 | 118,349 | 75,780 | 438,116 |

*Limestone and marble sold by producers at Mankato and Kasota, Minn., 1934–38*

| Year | Building stone (rough and dressed) | | Other uses | | Total | |
|---|---|---|---|---|---|---|
| | Cubic feet | Value | Short tons | Value | Short tons (approximate) | Value |
| 1934 | 99,010 | $188,484 | 13,940 | $10,119 | 21,360 | $198,603 |
| 1935 | 83,020 | 111,396 | 35,320 | 21,530 | 41,410 | 132,926 |
| 1936 | 157,130 | 332,699 | 51,090 | 54,163 | 68,570 | 386,862 |
| 1937 | 143,580 | 251,164 | 36,860 | 40,106 | 47,750 | 291,270 |
| 1938 | 123,780 | 199,997 | (1) | (1) | [2] 9,990 | [2] 199,997 |

[1] Bureau of Mines not at liberty to publish figures.
[2] Exclusive of "Other uses."

## SANDSTONE

Sales of cut stone, slabs, and mill blocks of sandstone declined 27 percent in quantity and 32 percent in value in 1938. The output of stone for rough construction and rubble decreased greatly. Sales of paving blocks, which had dwindled almost to the vanishing point in 1937, increased more than tenfold in 1938. The output of curbing was much larger than in 1937, but sales of flagging were smaller. The average value of rough construction stone at the mill or quarry was higher than in 1937, and that of cut stone was lower.

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*Sandstone (dimension stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Building | | | | | | | | Paving blocks | | Curbing | | Flagging | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Rough construction | | Rough architectural | | Dressed (sawed and cut) | | Rubble | | | | | | | | | |
| | | Short tons | Value | Cubic feet | Value | Cubic feet | Value | Short tons | Value | Number | Value | Cubic feet | Value | Cubic feet | Value | Short tons (approximate) | Value |
| Arizona | 3 | 3,050 | $4,565 | | | | | | | | | | | 400 | $1,710 | 3,080 | $6,275 |
| California | 4 | 24,910 | 13,534 | (1) | (1) | | | (1) | (1) | | | | | 18,690 | 10,152 | 27,280 | 25,054 |
| Colorado | 3 | 3,840 | 13,107 | | | | | | | | | | | 750 | 780 | 3,900 | 13,887 |
| Connecticut | 1 | | | (1) | (1) | | | | | | | | | | | (1) | (1) |
| Idaho | 1 | (1) | (1) | | | | | | | | | | | | | (1) | (1) |
| Indiana | 1 | (1) | (1) | | | | | | | | | | | (1) | (1) | (1) | (1) |
| Kansas | 1 | (1) | (1) | | | | | | | | | | | (1) | (1) | (1) | (1) |
| Maryland | 5 | 1,360 | 1,738 | | | | | | | | | | | 36,960 | 9,494 | 4,310 | 11,232 |
| Massachusetts | 1 | (1) | (1) | (1) | (1) | (1) | (1) | | | | | | | | | (1) | (1) |
| Minnesota | 1 | | | | | | | (1) | (1) | (1) | (1) | | | | | (1) | (1) |
| New Jersey | 1 | (1) | (1) | | | | | | | | | | | | | (1) | (1) |
| New York | 22 | 1,130 | 3,448 | 7,090 | $3,799 | (1) | (1) | (1) | (1) | (1) | (1) | 158,250 | $171,118 | 83,130 | 54,057 | 25,060 | 290,334 |
| Ohio | 9 | 8,430 | 84,180 | 46,570 | 22,020 | 235,920 | $297,073 | 270 | $1,067 | | | 278,980 | 258,760 | 96,150 | 94,547 | 54,960 | 757,647 |
| Pennsylvania | 25 | 11,720 | 32,269 | | | 1,900 | 5,856 | 7,360 | 13,844 | | | 43,720 | 44,724 | 90,510 | 112,317 | 30,320 | 209,010 |
| Tennessee | 3 | (1) | (1) | | | | | (1) | (1) | | | | | 24,240 | 40,418 | 7,340 | 66,341 |
| Virginia | 7 | 2,180 | 3,241 | | | | | | | | | | | 14,190 | 4,674 | 3,180 | 7,915 |
| Washington | 1 | | | | | 2,490 | 13,695 | 200 | 468 | | | | | 2,030 | 2,563 | 560 | 16,726 |
| Wisconsin | 2 | 1,250 | 4,700 | 2,400 | 2,400 | | | | | | | | | 500 | 160 | 1,470 | 7,260 |
| Undistributed | | 6,420 | 29,637 | 8,040 | 14,170 | 28,120 | 81,431 | 3,160 | 8,324 | 135,700 | $10,187 | | | 4,500 | 3,450 | 4,660 | 61,996 |
| | 91 | 64,290 | 190,419 | 64,100 | 42,389 | 268,430 | 398,055 | 10,990 | 23,703 | 135,700 | 10,187 | 480,950 | 474,602 | 372,050 | 334,322 | 166,120 | 1,473,677 |
| Short tons (approximate) | | (2) | | 4,450 | | 19,770 | | | | 1,330 | | 35,810 | | 29,480 | | | |

[1] Included under "Undistributed."

[2] 829,450 cubic feet (approximate).

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*Bluestone sold or used by producers in the United States (all from New York and Pennsylvania) in 1938, by uses* [1]

| State | Dimension stone | | | | | | | | | Other uses | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Building | | Curbing | | Flagging | | Total | | | | |
| | Cubic feet | Value | Cubic feet | Value | Cubic feet | Value | Cubic feet | Short tons (approximate) | Value | Short tons | Value |
| New York | 29,830 | $51,402 | 118,270 | $133,028 | 81,370 | $51,369 | 229,470 | 19,390 | $235,799 | 16,700 | $16,435 |
| Pennsylvania | 5,920 | 6,555 | 18,720 | 19,724 | 75,560 | 107,779 | 100,200 | 8,470 | 134,058 | ------ | ------- |
| | 35,750 | 57,957 | 136,990 | 152,752 | 156,930 | 159,148 | 329,670 | 27,860 | 369,857 | 16,700 | 16,435 |

[1] Included in foregoing figures for sandstone.

## MISCELLANEOUS STONE

The following table includes certain types of dimension stone not included in any of the groups already discussed. The principal varieties are mica schist, argillite, various light-colored volcanic rocks, and soapstone.

*Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Building | | | | Flagging | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | Rough and dressed | | Rubble | | | | | |
| | | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alaska | 1 | ------ | ------ | (1) | (1) | ------ | ------ | (1) | (1) |
| California | 6 | (1) | (1) | (1) | (1) | ------ | ------ | 3,090 | $4,222 |
| District of Columbia | 1 | ------ | ------ | (1) | (1) | ------ | ------ | (1) | (1) |
| Florida | 1 | ------ | ------ | (1) | (1) | ------ | ------ | (1) | (1) |
| Georgia | 2 | (1) | (1) | ------ | ------ | (1) | (1) | (1) | (1) |
| Maryland | 4 | 4,830 | $12,190 | (1) | (1) | (1) | (1) | 8,130 | 17,869 |
| Nevada | 1 | ------ | ------ | (1) | (1) | ------ | ------ | (1) | (1) |
| New Jersey | 2 | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) |
| New York | 3 | (1) | (1) | ------ | ------ | (1) | (1) | 1,120 | 3,528 |
| Pennsylvania | 8 | 14,150 | 21,585 | ------ | ------ | ------ | ------ | 14,150 | 21,585 |
| Puerto Rico | 1 | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) |
| Virginia | 2 | (1) | (1) | ------ | ------ | ------ | ------ | (1) | (1) |
| Undistributed | ------ | 9,940 | 481,262 | 81,600 | $71,203 | 1,920 | $8,920 | 85,950 | 547,956 |
| | 32 | [2] 28,920 | 515,037 | 81,600 | 71,203 | [2] 1,920 | 8,920 | 112,440 | 595,160 |

[1] Included under "Undistributed."
[2] Building stone, approximately 332,700 cubic feet; flagging, approximately 20,410 cubic feet.

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## TRENDS IN THE USE OF BUILDING AND MEMORIAL STONE

Total building activity (residential plus nonresidential) in 1938 was just about the same as in 1937, while nonresidential building, where stone finds its chief market, receded moderately from the level of 1937. As indicated in figures 1 and 2, sales of building granite and

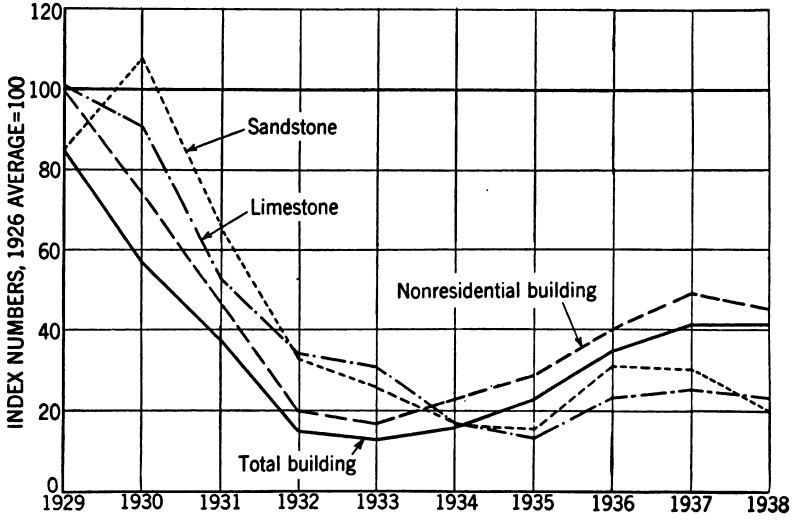


FIGURE 1.—Sales value of limestone and sandstone compared with total building and nonresidential building, 1929–38. To facilitate comparison, unlike units have been reduced to percentages of the 1926 value. Stone figures include rough and dressed stone; building contracts are from F. W. Dodge Corporation.

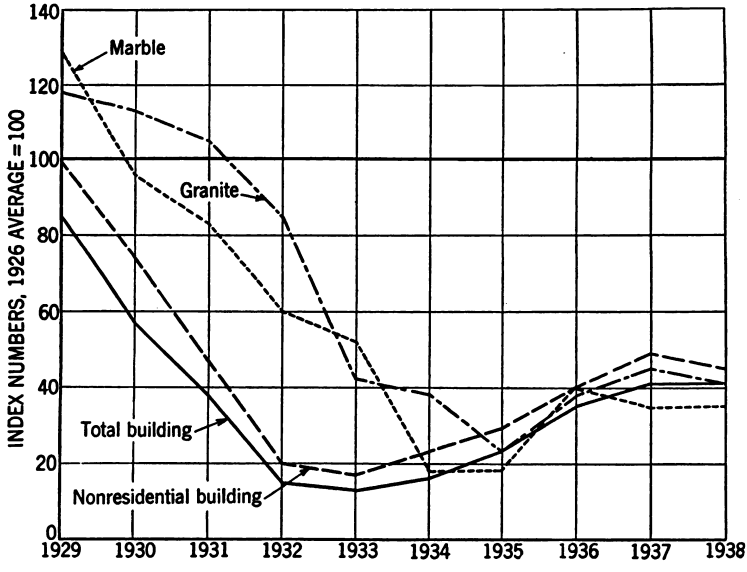


FIGURE 2.—Sales value of building marble and granite compared with total building and nonresidential building, 1929–38. To facilitate comparison, unlike units have been reduced to percentages of the 1926 value. Stone figures include rough and dressed stone; building contracts are from F. W. Dodge Corporation.

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limestone declined to about the same extent as nonresidential building, and marble sales were almost as high as in 1937, but the output of building sandstone was only about two-thirds as great as in 1937. The encouraging upturn in building contracts awarded during the late months of 1938 did not have its full effect on stone sales, because actual construction on many of the contracts did not begin until 1939. The dignity, endurance, and fire resistance of natural stone should encourage its wider use in buildings of better class. A statistical history of building stone appeared recently,[1] which showed trends during recent years and discussed reasons for declining use.

Sales of memorial granite fell 21 percent, while the output of memorial marble remained virtually the same in 1938 as in 1937.

## NEW DEVELOPMENTS

In England the surfaces of limestone buildings have been cleaned effectively, even where the stone is encrusted with greasy soot, by applying a fine, misty spray of water to the surface for 1 or 2 hours before brushing.

In Europe unusually exhaustive study and research have been devoted to the weathering, discoloration, decay, frost-resistance, preservation, cleaning, and repair of building stones. These problems are of greater immediate importance in the older civilizations where stone buildings were erected centuries ago than in America where even our oldest stone structures are comparatively young from the standpoint of the life of high-grade building stone.

Blocks of natural sandstone known as "firestone" are being used to an increasing extent as refractories. Suitable material comes chiefly from the well-known sandstone area near Amherst in northern Ohio. The cementing material between the silica grains is amorphous silica, with small quantities of iron and alumina compounds. The structure is somewhat open, permitting expansion and contraction with little spalling at high temperature. Refractories of this type are well-adapted for lining soaking pits, bessemer converters, cupolas, and ladles.

Wire saws were used with fair success in 1938 in making major cuts in a marble quarry near Knoxville, Tenn. The average rate of cutting, including all delays, was 7.3 square feet per hour for a 24-hour day.

A publication [2] that may be of interest to stone producers was reprinted recently.

## CRUSHED AND BROKEN STONE

More than 123,000,000 tons of crushed and broken stone were sold in 1938 exclusive of that used for making cement and lime. Sales decreased 6 percent in quantity and 4 percent in value in 1938 compared with 1937. Encouraging gains in sales for the largest uses—highway construction and concrete aggregate—were more than offset by the notable decline in stone used by the iron and steel industries. The demand for stone in manufacturing plants (except sugar factories) also receded considerably from the level of 1937. Sales of agricultural limestone declined 13 percent.

[1] Bowles, Oliver, and Schauble, Mabel, Trends in Prices and Sales of Building Stone: Stone, vol. 59, November 1938, pp. 417–418; December 1938, pp. 462–463.

[2] Bowles, Oliver, The Stone Industries: McGraw-Hill Book Co., Inc., New York. 2d ed., 1939, 519 pp.

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The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1937 and 1938, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters of this volume on Asphalt and Slate.

*Crushed and broken stone sold or used by producers in the United States, 1937–38, by principal uses*

| Use | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average | | Total | Average |
| Concrete and road metal | 80,271,900 | $76,972,465 | $0.96 | 88,787,080 | $84,212,446 | $0.95 |
| Railroad ballast | 8,160,670 | 5,852,143 | .72 | 5,975,970 | 4,554,775 | .76 |
| Metallurgical | 21,331,970 | 14,704,458 | .69 | 9,702,860 | 6,943,429 | .72 |
| Alkali works | 4,860,520 | 2,295,599 | .47 | 3,634,050 | 1,743,173 | .48 |
| Riprap | 5,388,920 | 5,850,101 | 1.09 | 6,210,520 | 6,995,418 | 1.13 |
| Agricultural | 5,004,930 | 6,454,695 | 1.29 | 4,367,410 | 5,637,485 | 1.29 |
| Refractory (ganister, mica schist, dolomite, soapstone) | 1,525,260 | 2,258,900 | 1.48 | 659,690 | 991,765 | 1.50 |
| Asphalt filler | 351,590 | 686,951 | 1.95 | 288,590 | 789,587 | 2.74 |
| Calcium carbide works | 472,240 | 266,557 | .56 | 246,010 | 137,522 | .56 |
| Sugar factories | 566,620 | 862,660 | 1.52 | 619,910 | 878,028 | 1.42 |
| Glass factories | 274,770 | 460,352 | 1.68 | 170,560 | 290,297 | 1.70 |
| Paper mills | 322,810 | 589,091 | 1.82 | 223,450 | 373,207 | 1.67 |
| Other uses | 2,729,810 | 4,626,619 | 1.69 | 2,186,720 | 3,929,752 | 1.80 |
| | 131,262,010 | 121,880,591 | .93 | 123,072,820 | 117,476,884 | .95 |
| Portland cement (including "cement rock") [1] | 29,547,000 | (2) | | 26,183,000 | (2) | |
| Natural cement ("cement rock") [1] | | | | | | |
| Lime [3] | 8,250,000 | (2) | | 6,694,000 | (2) | |
| Total stone | 169,059,000 | | | 155,950,000 | | |
| Asphaltic stone | 447,213 | 2,035,410 | 4.55 | 483,497 | 2,409,616 | 4.98 |
| Slate granules and flour | 277,010 | 1,578,014 | 5.70 | 349,000 | 2,489,962 | 7.14 |

[1] Value reported as cement in the chapter on Cement.
[2] No value available for stone used in manufacture of cement and lime.
[3] Value reported as lime in chapter on Lime.

The following tables show production and value of stone used for concrete aggregate, road construction, and railroad ballast for a series of years and by States for 1938.

*Concrete and road metal and railroad ballast sold or used by producers in the United States, 1934–38*

| Year | Concrete and road metal | | Railroad ballast | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 55,244,470 | $52,471,430 | 5,323,450 | $3,995,177 | 60,567,920 | $56,466,607 |
| 1935 | 49,487,510 | 44,888,513 | 5,267,010 | 4,011,469 | 54,754,520 | 48,899,982 |
| 1936 | 79,336,740 | 76,095,094 | 7,934,080 | 6,022,693 | 87,270,820 | 82,117,787 |
| 1937 | 80,271,900 | 76,972,465 | 8,160,670 | 5,852,143 | 88,432,570 | 82,824,608 |
| 1938 | 88,787,080 | 84,212,446 | 5,975,970 | 4,554,775 | 94,763,050 | 88,767,221 |

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*Concrete and road metal, and railroad ballast sold or used by producers in the United States in 1938, by States*

| State | Concrete and road metal | | Railroad ballast | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 464,020 | $469,947 | | | 464,020 | $469,947 |
| Alaska | 125,310 | 143,571 | | | 125,310 | 143,571 |
| Arizona | [1] 365,070 | [1] 278,575 | (2) | (2) | [1] 365,070 | [1] 278,575 |
| Arkansas | [1] 253,450 | [1] 201,120 | 190,910 | $140,951 | [1] 444,360 | [1] 342,071 |
| California | 5,287,520 | 3,788,656 | 511,030 | 239,911 | 5,798,550 | 4,028,567 |
| Colorado | [1] 600,180 | [1] 556,833 | | | [1] 600,180 | [1] 556,833 |
| Connecticut | [1] 1,259,110 | [1] 1,197,857 | 168,850 | 143,454 | [1] 1,427,960 | [1] 1,341,311 |
| Delaware | (2) | (2) | | | (2) | (2) |
| Florida | 1,135,780 | 976,946 | (2) | (2) | [1] 1,135,780 | [1] 976,946 |
| Georgia | [1] 1,177,860 | [1] 1,262,234 | (2) | (2) | 1,229,970 | 1,297,791 |
| Hawaii | [1] 467,160 | [1] 685,408 | (2) | (2) | 505,780 | 724,045 |
| Idaho | 1,018,190 | 764,605 | (2) | (2) | [1] 1,018,190 | [1] 764,605 |
| Illinois | [1] 6,767,870 | [1] 5,600,395 | 220,130 | 153,755 | [1] 6,988,000 | [1] 5,754,150 |
| Indiana | 2,876,760 | 2,677,685 | 76,070 | 59,440 | 2,952,830 | 2,737,125 |
| Iowa | 2,899,530 | 3,352,928 | (2) | (2) | [1] 2,899,530 | [1] 3,352,928 |
| Kansas | [1] 3,161,800 | [1] 4,492,874 | 126,790 | 109,509 | [1] 3,288,590 | [1] 4,602,383 |
| Kentucky | 2,631,670 | 2,442,900 | 343,660 | 169,042 | 2,975,330 | 2,611,942 |
| Louisiana | (2) | (2) | | | (2) | (2) |
| Maine | 93,470 | 131,994 | | | 93,470 | 131,994 |
| Maryland | 756,100 | 782,475 | 34,140 | 33,888 | 790,240 | 816,363 |
| Massachusetts | [1] 1,382,560 | [1] 1,318,356 | [1] 102,040 | [1] 89,440 | 1,790,370 | 1,821,211 |
| Michigan | [1] 2,218,320 | [1] 1,133,246 | 64,640 | 39,173 | [1] 2,282,960 | [1] 1,172,419 |
| Minnesota | 795,900 | 798,925 | 1,200 | 1,550 | 797,100 | 800,475 |
| Missouri | [1] 2,217,690 | [1] 2,611,962 | 66,410 | 61,213 | [1] 2,284,100 | [1] 2,673,175 |
| Montana | 567,190 | 352,966 | (2) | (2) | [1] 567,190 | 352,966 |
| Nebraska | 369,510 | 470,925 | | | 369,510 | 470,925 |
| Nevada | 56,980 | 80,487 | | | 56,980 | 80,487 |
| New Hampshire | 27,090 | 34,936 | | | 27,090 | 34,936 |
| New Jersey | 2,395,620 | 2,256,034 | [1] 52,460 | [1] 53,456 | [1] 2,448,080 | [1] 2,309,490 |
| New Mexico | 696,110 | 437,714 | (2) | (2) | [1] 696,110 | [1] 437,714 |
| New York | 7,854,590 | 8,052,850 | [1] 444,270 | [1] 311,408 | [1] 8,298,860 | [1] 8,364,258 |
| North Carolina | 3,879,090 | 4,603,018 | 623,860 | 668,860 | 4,502,950 | 5,271,878 |
| North Dakota | 20,090 | 5,395 | | | 20,090 | 5,395 |
| Ohio | [1] 6,917,110 | [1] 5,693,137 | 476,950 | 348,469 | [1] 7,394,060 | [1] 6,041,606 |
| Oklahoma | 817,410 | 783,493 | 125,090 | 70,770 | 942,500 | 854,263 |
| Oregon | 1,701,640 | 1,269,781 | | | 1,701,640 | 1,269,781 |
| Pennsylvania | 7,505,720 | 7,129,840 | 279,950 | 263,629 | 7,785,670 | 7,393,469 |
| Puerto Rico | 225,990 | 238,426 | 13,620 | 9,470 | 239,610 | 247,896 |
| Rhode Island | [1] 185,220 | [1] 276,370 | | | [1] 185,220 | [1] 276,370 |
| South Carolina | [1] 510,160 | [1] 705,983 | 427,330 | 423,983 | [1] 937,490 | [1] 1,129,966 |
| South Dakota | [1] 187,490 | [1] 182,541 | | | [1] 187,490 | [1] 182,541 |
| Tennessee | 1,791,390 | 1,638,074 | 385,430 | 305,106 | 2,176,820 | 1,943,180 |
| Texas | [1] 2,774,720 | [1] 1,934,473 | 225,530 | 101,319 | [1] 3,000,250 | [1] 2,035,792 |
| Utah | 623,260 | 298,200 | (2) | (2) | [1] 623,260 | [1] 298,200 |
| Vermont | 189,680 | 205,369 | | | 189,680 | 205,369 |
| Virginia | [1] 3,634,050 | [1] 3,342,621 | [1] 406,600 | [1] 291,270 | 4,379,600 | 3,961,559 |
| Washington | [1] 1,780,560 | [1] 1,329,929 | | | [1] 1,780,560 | [1] 1,329,929 |
| West Virginia | [1] 2,042,020 | [1] 3,376,708 | 117,070 | 73,072 | [1] 2,159,090 | [1] 3,449,780 |
| Wisconsin | 2,488,170 | 2,086,129 | (2) | (2) | [1] 2,488,170 | [1] 2,086,129 |
| Wyoming | 89,350 | 100,453 | (2) | (2) | [1] 89,350 | [1] 100,453 |
| Undistributed | 1,501,550 | 1,657,102 | 491,940 | 392,637 | 1,258,040 | 1,234,462 |
| | 88,787,080 | 84,212,446 | 5,975,970 | 4,554,775 | 94,763,050 | 88,767,221 |

[1] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."
[2] Included under "Undistributed."

*Commercial and noncommercial operations.*—The following table shows production of crushed stone for concrete and road metal and railroad ballast during recent years by Government agencies of various kinds contrasted with that by commercial enterprises. Production by Government agencies increased 32 percent in 1938 compared with 1937, while commercial production decreased 3 percent.

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*Concrete and road metal and railroad ballast sold or used by commercial and noncommercial operators in the United States, 1934–38*

[Figures for "noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "commercial operations" represent tonnages reported by all other producers]

| Year | Commercial operations | | | | Noncommercial operation | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Average value per ton | Percent of change in quantity from preceding year | Percent of total quantity | Short tons | Average value per ton | Percent of change in quantity from preceding year | Percent of total quantity | Short tons | Percent of change in quantity from preceding year |
| 1934 | 43,259,180 | $0.94 | +14.3 | 71.4 | 17,308,740 | $0.91 | +126.2 | 28.6 | 60,567,920 | +33.1 |
| 1935 | 38,090,660 | .90 | −11.9 | 69.6 | 16,663,860 | .87 | −3.7 | 30.4 | 54,754,520 | −9.6 |
| 1936 | 57,494,430 | .93 | +50.9 | 65.9 | 29,776,390 | .95 | +78.7 | 34.1 | 87,270,820 | +59.4 |
| 1937 | 62,315,350 | .88 | +8.4 | 70.5 | 26,117,220 | 1.06 | −12.3 | 29.5 | 88,432,570 | +1.3 |
| 1938 | 60,254,170 | .88 | −3.3 | 63.6 | 34,508,880 | 1.04 | +32.1 | 36.4 | 94,763,050 | +7.2 |

*Methods of transportation.*—The following table shows the quantities of concrete and road metal conveyed by each of the principal means of transportation during 1938.

*Concrete and road metal shipped by commercial and noncommercial operators in the United States in 1938, by methods of transportation* [1]

| Method of transportation | Commercial operations | | Noncommercial operations | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Percent of total | Short tons | Percent of total | Short tons | Percent of total |
| Railroad | 12,032,490 | 22.2 | | | 12,032,490 | 13.5 |
| Water | 5,398,770 | 9.9 | | | 5,398,770 | 6.1 |
| Truck | 32,779,040 | 60.4 | 34,508,880 | 100.0 | 67,287,920 | 75.8 |
| Unspecified | 4,067,900 | 7.5 | | | 4,067,900 | 4.6 |
| Total: | | | | | | |
| Quantity | 54,278,200 | 100.0 | 34,508,880 | 100.0 | 88,787,080 | 100.0 |
| Value | $48,427,045 | | $35,785,401 | | $84,212,446 | |

[1] Exclusive of railroad ballast, virtually all of which is shipped by rail.

## GRANITE

Sales of crushed granite increased 15 percent in quantity and 27 percent in value in 1938 compared with 1937. That used for concrete aggregate and road construction made only a small gain, but sales of both railroad ballast and riprap were far in advance of 1937 and the unit values of these products were much higher. The price of ballast per ton at the quarry increased from 65 cents to 88 cents and that of riprap from $1.07 to $1.44. A large part of the riprap production was noncommercial.

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*Granite (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Riprap | | Crushed stone | | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Concrete and road metal | | Railroad ballast | | | | | |
| | | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 1 | | | (1) | (1) | | | | | (1) | (1) |
| Arizona | 4 | (1) | (1) | (1) | (1) | (1) | (1) | | | 30,380 | $15,035 |
| California | 20 | 394,220 | $359,516 | 364,340 | $240,400 | (1) | (1) | (1) | (1) | 1,088,720 | 735,948 |
| Colorado | 15 | | | 161,940 | 164,677 | | | | | 161,940 | 164,677 |
| Connecticut | 3 | (1) | (1) | | | | | (1) | (1) | 11,160 | 27,483 |
| Delaware | 2 | (1) | (1) | (1) | (1) | | | | | (1) | (1) |
| Georgia | 34 | 22,470 | 21,340 | 879,720 | 948,277 | (1) | (1) | (1) | (1) | 965,070 | 1,012,662 |
| Idaho | 4 | | | (1) | (1) | | | | | (1) | (1) |
| Maine | 7 | (1) | (1) | (1) | (1) | | | | | 58,880 | 80,858 |
| Maryland | 6 | 29,080 | 37,252 | 38,130 | 53,718 | | | 120 | $162 | 67,330 | 91,132 |
| Massachusetts | 14 | (1) | (1) | 309,810 | 375,957 | (1) | (1) | (1) | (1) | 344,410 | 420,527 |
| Minnesota | 13 | (1) | (1) | 25,430 | 37,001 | | | (1) | (1) | 31,460 | 44,660 |
| Missouri | 2 | 2,700 | 1,814 | | | | | | | 2,700 | 1,814 |
| Montana | 3 | 596,890 | 1,214,337 | 18,340 | 7,501 | | | | | 615,230 | 1,221,838 |
| New Hampshire | 10 | 4,350 | 2,993 | 25,340 | 32,188 | | | | | 29,690 | 35,181 |
| New Jersey | 2 | | | (1) | (1) | (1) | (1) | | | (1) | (1) |
| New York | 24 | 239,550 | 239,549 | 539,660 | 555,192 | 9,200 | $7,080 | | | 788,410 | 801,821 |
| North Carolina | 90 | 690 | 509 | 2,550,240 | 3,191,033 | 623,860 | 668,860 | 5,380 | 31,835 | 3,180,170 | 3,892,237 |
| Oklahoma | 3 | (1) | (1) | (1) | (1) | | | | | 4,500 | 3,450 |
| Pennsylvania | 9 | 330 | 136 | 160,090 | 196,445 | | | 2,270 | 3,810 | 162,690 | 200,391 |
| Rhode Island | 6 | (1) | (1) | (1) | (1) | | | | | 67,360 | 113,923 |
| South Carolina | 6 | 8,670 | 10,465 | 507,830 | 703,653 | 427,330 | 423,983 | 28,930 | 10,435 | 972,760 | 1,148,536 |
| South Dakota | 40 | (1) | (1) | (1) | (1) | | | | | 22,360 | 47,832 |
| Tennessee | 3 | | | 50,020 | 54,071 | | | | | 50,020 | 54,071 |
| Texas | 1 | (1) | (1) | | | | | | | (1) | (1) |
| Utah | 1 | | | (1) | (1) | | | (1) | (1) | (1) | (1) |
| Vermont | 1 | | | (1) | (1) | | | | | (1) | (1) |
| Virginia | 8 | (1) | (1) | 519,630 | 503,623 | (1) | (1) | | | 656,680 | 609,623 |
| Washington | 5 | (1) | (1) | 89,500 | 95,484 | | | (1) | (1) | 104,510 | 107,649 |
| Wisconsin | 11 | 2,470 | 3,000 | 6,260 | 9,122 | | | 2,010 | 9,246 | 10,740 | 21,368 |
| Undistributed | | 67,260 | 79,452 | 388,990 | 463,565 | 568,550 | 332,960 | 88,750 | 46,936 | 333,180 | 284,861 |
| | 348 | 1,368,680 | 1,970,363 | 6,635,270 | 7,631,907 | 1,628,940 | 1,432,883 | 127,460 | 102,424 | 9,760,350 | 11,137,577 |

[1] Included under "Undistributed."

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## BASALT

Basalt, gabbro, diorite, and other dark igneous rocks, known commercially as trap rock, are used widely for road building because of their toughness and excellent wearing qualities. Sales for this use and for concrete aggregate were about the same in 1938 as in 1937, but the output of riprap was nearly 2½ times as great as in 1937. The increase was general and consisted chiefly of the output of commercial companies. The larger output of New England was due to demands for stone to remedy the ravages of the hurricane. Prices of aggregates and road stone at the quarry were 4 cents a ton lower in 1938 than in 1937, and those of riprap were 5 cents lower.

*Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Riprap | | Crushed stone | | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Short tons | Value | Concrete and road metal | | Railroad ballast | | Short tons | Value | Short tons | Value |
| | | | | Short tons | Value | Short tons | Value | | | | |
| California | 11 | 290,160 | $279,097 | 428,480 | $442,921 | (1) | (1) | (1) | (1) | 781,310 | $770,941 |
| Colorado | 4 | 27,720 | 28,556 | 116,100 | 106,586 | | | | | 143,820 | 135,142 |
| Connecticut | 17 | 25,510 | 19,386 | 1,259,110 | 1,197,857 | 168,850 | $143,454 | | | 1,453,470 | 1,360,697 |
| Hawaii | 14 | 9,050 | 2,075 | 467,160 | 685,408 | (1) | (1) | (1) | (1) | 476,230 | 687,531 |
| Idaho | 27 | (1) | (1) | 922,810 | 720,858 | (1) | (1) | | | 924,630 | 721,525 |
| Maine | 3 | | | 14,390 | 10,548 | | | | | 14,390 | 10,548 |
| Maryland | 5 | (1) | (1) | (1) | (1) | | | | | 78,830 | 101,292 |
| Massachusetts | 17 | 177,670 | 70,904 | 1,072,750 | 942,399 | 102,040 | 89,440 | | | 1,352,460 | 1,102,743 |
| Michigan | 6 | | | (1) | (1) | | | (1) | (1) | 129,850 | 135,769 |
| Minnesota | 1 | | | (1) | (1) | (1) | (1) | | | (1) | (1) |
| Montana | 14 | 21,220 | 13,432 | 443,080 | 284,319 | | | | | 464,300 | 297,751 |
| Nevada | 1 | | | (1) | (1) | | | | | (1) | (1) |
| New Jersey | 23 | 2,370 | 2,833 | 2,205,030 | 2,055,826 | 52,460 | 53,456 | | | 2,259,860 | 2,112,115 |
| New York | 3 | | | (1) | (1) | (1) | (1) | | | 925,690 | 1,000,471 |
| North Carolina | 6 | | | 58,700 | 54,603 | | | | | 58,700 | 54,603 |
| Oregon | 122 | 322,730 | 350,398 | 1,586,530 | 1,194,261 | | | 8,080 | $5,388 | 1,917,340 | 1,550,047 |
| Pennsylvania | 9 | (1) | (1) | 598,850 | 545,075 | 72,990 | 68,577 | (1) | (1) | 674,150 | 618,049 |
| Texas | 1 | | | (1) | (1) | (1) | (1) | | | (1) | (1) |
| Virginia | 6 | | | 212,910 | 187,491 | | | | | 212,910 | 187,491 |
| Washington | 90 | 367,330 | 216,567 | 1,553,850 | 1,062,930 | | | | | 1,921,180 | 1,279,497 |
| Wisconsin | 2 | | | (1) | (1) | | | | | (1) | (1) |
| Undistributed | | 4,750 | 3,885 | 1,149,870 | 1,286,738 | 132,470 | 123,559 | 11,920 | 9,638 | 97,820 | 132,253 |
| | 382 | 1,248,510 | 987,133 | 12,089,620 | 10,777,820 | 528,810 | 478,486 | 20,000 | 15,026 | 13,886,940 | 12,258,465 |

[1] Included under "Undistributed."

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## MARBLE

Marble may be used for virtually the same purposes as crushed limestone, and producers of building and monumental marble find outlets for waste stone in the form of crushed and pulverized products.

*Marble (crushed and broken stone) sold by producers in the United States in 1938, by States* [1]

| State | Active plants | Short tons | Value | State | Active plants | Short tons | Value |
|---|---|---|---|---|---|---|---|
| Alabama | 3 | 27,250 | $44,900 | Tennessee | 4 | 50,590 | $37,178 |
| Arkansas | 1 | 480 | 2,415 | Vermont | 2 | 820 | 5,844 |
| Georgia | 1 | 10,490 | 20,970 | Undistributed [2] | 12 | 24,280 | 120,601 |
| Maryland | 1 | 2,190 | 24,269 | | | | |
| Massachusetts | 1 | 2,510 | 1,704 | | 26 | 130,390 | 275,225 |
| Missouri | 1 | 11,780 | 17,344 | | | | |

[1] Includes stone used for artificial stone, crushed stone, flux, riprap, stucco, terrazzo, whiting substitute, and uses not specified.
[2] Arizona, California, New York, Virginia, and Washington.

## LIMESTONE

Limestone comprised 66 percent of all crushed and broken stone sold in 1938 (excluding that used for making cement and lime). It is employed more extensively than other rocks because it is widely distributed and therefore available to a multitude of markets and because it can be quarried and crushed at moderate cost. Furthermore, limestone is essential to many commodities and to a host of chemical and manufacturing processes. The following tables show production by States and uses during 1938 and sales for miscellaneous industrial uses.

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*Limestone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Riprap | | Fluxing stone | | Crushed stone | | | | Agriculture | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Concrete and road metal | | Railroad ballast | | | | | | | |
| | | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 38 | (1) | (1) | 690,600 | $494,247 | 325,000 | $349,826 | | | (1) | (1) | (1) | (1) | 1,123,650 | $965,251 |
| Arizona | 8 | (1) | (1) | (1) | (1) | 29,000 | 37,222 | | | | | | | 58,170 | 57,080 |
| Arkansas | 16 | (1) | (1) | (1) | (1) | 59,940 | 49,567 | (1) | (1) | 12,520 | $21,712 | (1) | (1) | 114,070 | 128,241 |
| California | 22 | 471,320 | $942,441 | 23,230 | 34,314 | 62,340 | 38,095 | | | 510 | 1,398 | 209,490 | $515,803 | 766,890 | 1,532,051 |
| Colorado | 11 | | | (1) | (1) | (1) | (1) | | | | | 52,080 | 88,012 | 252,230 | 232,905 |
| Connecticut | 4 | | | (1) | (1) | (1) | (1) | | | 32,100 | 117,100 | 14,070 | 52,814 | 48,080 | 173,040 |
| Florida | 33 | 7,020 | 7,050 | | | 1,104,720 | 908,426 | (1) | (1) | 35,110 | 75,194 | (1) | (1) | 1,303,320 | 1,040,864 |
| Georgia | 20 | | | (1) | (1) | 284,850 | 294,246 | | | (1) | (1) | 66,770 | 163,651 | 356,710 | 467,371 |
| Hawaii | 1 | | | | | | | | | (1) | (1) | | | (1) | (1) |
| Idaho | 5 | (1) | (1) | (1) | (1) | (1) | (1) | | | | | (1) | (1) | 27,670 | 30,674 |
| Illinois | 245 | 103,100 | 106,185 | 141,780 | 116,581 | 6,729,280 | 5,584,382 | 220,130 | $153,755 | 1,095,640 | 1,003,385 | 152,560 | 290,829 | 8,442,490 | 7,255,117 |
| Indiana | 192 | 30,260 | 19,659 | 23,640 | 16,475 | 2,833,300 | 2,634,453 | 76,070 | 59,440 | 352,390 | 367,204 | 119,340 | 115,112 | 3,435,000 | 3,212,343 |
| Iowa | 226 | 182,180 | 113,089 | (1) | (1) | 2,853,530 | 3,313,028 | (1) | (1) | 236,300 | 207,883 | 40,570 | 97,976 | 3,320,510 | 3,739,573 |
| Kansas | 212 | 283,140 | 199,994 | | | 2,998,950 | 4,271,228 | 126,790 | 109,509 | 16,760 | 19,750 | 3,220 | 7,105 | 3,428,860 | 4,607,586 |
| Kentucky | 130 | 35,630 | 32,316 | | | 2,631,670 | 2,442,900 | 343,660 | 169,042 | 321,130 | 301,546 | 9,830 | 14,431 | 3,341,920 | 2,960,235 |
| Louisiana | 1 | | | | | (1) | (1) | | | | | (1) | (1) | (1) | (1) |
| Maine | 3 | | | (1) | (1) | (1) | (1) | | | (1) | (1) | (1) | (1) | 36,280 | 95,383 |
| Maryland | 16 | (1) | (1) | | | 532,850 | 520,396 | (1) | (1) | 3,610 | 9,229 | (1) | (1) | 558,890 | 553,760 |
| Massachusetts | 9 | | | (1) | (1) | | | | | 75,960 | 272,728 | (1) | (1) | 97,210 | 332,383 |
| Michigan | 25 | 39,420 | 10,883 | 2,584,220 | 1,223,819 | 2,091,260 | 1,002,438 | 64,640 | 39,173 | 108,130 | 71,454 | 2,635,160 | 1,278,706 | 7,522,830 | 3,626,473 |
| Minnesota | 83 | 38,240 | 47,861 | (1) | (1) | 744,870 | 726,953 | (1) | (1) | 25,230 | 29,203 | (1) | (1) | 817,460 | 832,585 |
| Missouri | 280 | 659,710 | 837,079 | 32,210 | 35,169 | 2,217,690 | 2,611,962 | 66,410 | 61,213 | 150,920 | 162,430 | 125,910 | 233,852 | 3,252,850 | 3,941,705 |
| Montana | 7 | | | (1) | (1) | 29,880 | 10,101 | (1) | (1) | | | 44,300 | 58,101 | 124,150 | 104,557 |
| Nebraska | 24 | 118,900 | 214,961 | (1) | (1) | 369,510 | 470,925 | | | 550 | 1,437 | (1) | (1) | 510,240 | 780,664 |
| Nevada | 3 | | | (1) | (1) | (1) | (1) | | | (1) | (1) | (1) | (1) | 55,720 | 72,579 |
| New Jersey | 4 | | | (1) | (1) | (1) | (1) | | | (1) | (1) | (1) | (1) | 162,370 | 388,011 |
| New Mexico | 6 | 2,240 | 570 | | | 263,710 | 196,245 | | | | | | | 265,950 | 196,815 |
| New York | 152 | 219,140 | 257,372 | 11,690 | 12,120 | 6,023,300 | 6,226,976 | 435,070 | 304,328 | 167,290 | 392,093 | 956,800 | 703,677 | 7,813,290 | 7,896,566 |
| North Carolina | 4 | | | | | 70,710 | 71,796 | | | 11,840 | 13,024 | | | 82,550 | 84,820 |
| Ohio | 184 | 136,950 | 106,112 | 1,600,490 | 1,034,367 | 6,651,950 | 5,481,289 | 476,950 | 348,469 | 346,870 | 421,333 | 274,740 | 422,152 | 9,487,950 | 7,813,722 |
| Oklahoma | 56 | (1) | (1) | | | 788,750 | 754,669 | (1) | (1) | 30,520 | 59,999 | 68,290 | 105,833 | 1,010,060 | 1,002,776 |
| Oregon | 5 | | | | | (1) | (1) | | | 15,410 | 42,889 | (1) | (1) | 29,720 | 70,909 |
| Pennsylvania | 182 | 8,560 | 7,040 | 3,247,110 | 2,899,018 | 4,103,760 | 4,256,604 | 111,530 | 105,196 | 312,010 | 760,078 | 347,870 | 854,165 | 8,130,840 | 8,882,101 |
| Puerto Rico | 34 | | | | | (1) | (1) | (1) | (1) | | | | | 150,910 | 168,042 |
| Rhode Island | 1 | | | (1) | (1) | | | | | (1) | (1) | (1) | (1) | (1) | (1) |
| South Carolina | 2 | | | | | (1) | (1) | | | (1) | (1) | | | (1) | (1) |

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| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Dakota | 19 | 16,730 | 32,863 | | | 13,241 | 1,683,670 | 1,529,796 | 385,430 | 305,106 | | 297,845 | 5,850 | 95,545 | 2,405,060 | 2,245,593 |
| Tennessee | 129 | 3,750 | 4,060 | 13,180 | | | | | | | | | | | | |
| Texas | 65 | 26,230 | 22,562 | 38,690 | | 28,672 | 1,709,770 | 1,163,215 | 171,840 | 67,366 | 100 | 350 | 124,380 | 128,992 | 2,071,010 | 1,411,157 |
| Utah | 13 | | | (1) | | (1) | 126,050 | 66,981 | | | | | (1) | (1) | 245,420 | 161,098 |
| Vermont | 14 | | | | | | (1) | (1) | | | | | (1) | (1) | 48,950 | 91,812 |
| Virginia | 126 | 52,720 | 27,327 | 234,400 | | 220,004 | 2,699,490 | 2,433,910 | 383,660 | 276,947 | | (1) | 456,620 | 400,394 | 4,146,350 | 3,746,011 |
| Washington | 7 | | | (1) | | (1) | 137,210 | 171,515 | | | | 387,429 | (1) | 144,918 | 250,110 | 377,286 |
| West Virginia | 102 | 13,840 | 10,651 | 691,160 | | 564,176 | 1,136,110 | 2,076,955 | 117,070 | 73,072 | | (1) | 66,210 | 171,607 | 2,211,100 | 3,030,822 |
| Wisconsin | 153 | 88,170 | 71,246 | 27,410 | | 18,114 | 2,325,850 | 1,916,185 | (1) | (1) | | 134,361 | 175,340 | (1) | 2,626,860 | 2,240,367 |
| Wyoming | 7 | (1) | (1) | (1) | | (1) | 87,920 | 99,015 | (1) | (1) | | 141,121 | (1) | (1) | 249,240 | 331,886 |
| Undistributed | | 53,520 | 36,190 | 332,320 | | 223,304 | 583,650 | 621,119 | 208,520 | 138,265 | | 325,310 | 196,910 | 799,530 | 1,123,479 | 508,490 | 373,993 |
| | 2,879 | 2,590,770 | 3,107,511 | 9,692,130 | | 6,933,621 | 54,367,130 | 52,387,376 | 3,187,770 | 2,210,881 | | 5,637,485 | 4,367,410 | 6,780,400 | 7,073,004 | 80,975,610 | 77,349,878 |

[1] Included under "Undistributed."



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*Limestone sold or used by producers in the United States for miscellaneous uses, 1937–38*

| Use | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Alkali works | 4,860,520 | $2,295,599 | 3,634,050 | $1,743,173 |
| Calcium carbide works | 472,240 | 266,557 | 246,010 | 137,522 |
| Coal-mine dusting | 64,610 | 227,061 | 50,890 | 178,263 |
| Filler (not whiting substitute): | | | | |
| Asphalt | 351,590 | 686,951 | 288,590 | 789,587 |
| Fertilizer | 74,400 | 174,218 | 121,130 | 202,189 |
| Other | 20,890 | 38,726 | 61,970 | 245,356 |
| Filter beds | 34,970 | 34,250 | 142,050 | 127,586 |
| Glass factories | 274,770 | 460,352 | 170,560 | 290,297 |
| Limestone sand | | | 229,890 | 180,863 |
| Magnesia works (dolomite) | 96,730 | 158,023 | 62,540 | 99,684 |
| Mineral food | 67,230 | 238,847 | 65,570 | 226,844 |
| Mineral (rock) wool | 146,330 | 116,084 | 86,400 | 85,378 |
| Paper mills | 322,810 | 589,091 | 223,450 | 373,207 |
| Poultry grit | 27,360 | 118,343 | 31,260 | 153,789 |
| Refractory (dead-burned dolomite) | 576,900 | 580,720 | 263,930 | 274,624 |
| Road base | 206,060 | 106,931 | 205,840 | 117,882 |
| Stucco, terrazzo, and artificial stone | 36,180 | 152,788 | 23,360 | 146,828 |
| Sugar factories | 566,620 | 862,660 | 619,910 | 878,028 |
| Whiting substitute [1] | 194,080 | 923,494 | 145,170 | 671,842 |
| Other uses [2] | 173,000 | 328,768 | 80,350 | 89,447 |
| Use unspecified | 68,780 | 64,875 | 27,480 | 60,615 |
| | 8,636,070 | 8,424,338 | 6,780,400 | 7,073,004 |

[1] Includes stone for filler for graphite, calcimine, linoleum, paint, pigments, pottery, putty, regrinding, rubber, sealing wax, soap, tile, and uses not specified.

[2] Includes stone for acetic acid, acid neutralization, bird gravel, carbon dioxide, cement blocks, chemicals (unspecified), concrete blocks and pipes, dye works, explosives, fill, fireplace stone, foundry facings, lime burning, roofing gravel, sand, spalls, and waste rock.

Certain special uses of dolomite (calcium-magnesium carbonate) and its primary product of calcination, dolomitic lime, are covered in the following table:

*Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1937–38*

| | 1937 | 1938 |
|---|---|---|
| Dolomite for— | | |
| Basic magnesium carbonate: | | |
| Short tons | 96,730 | 62,540 |
| Value | $158,023 | $99,684 |
| Carbon dioxide | (1) | (1) |
| Dead-burned dolomite or refractory stone: | | |
| Short tons | 576,900 | 263,930 |
| Value | $580,720 | $274,624 |
| Dolomitic lime for— | | |
| Refractory (dead-burned dolomite): | | |
| Short tons | 617,706 | 366,626 |
| Value | $5,217,833 | $3,095,355 |
| Sulfite pulp: | | |
| Short tons | 43,000 | 39,000 |
| Value | $293,000 | $274,000 |
| Total (calculated as raw stone)—short tons | 1,995,000 | 1,168,000 |

[1] Data not available.

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Limestone is quarried not only for use in the raw state but also for manufacture into cement and lime. The large and important industries manufacturing these products are covered in separate chapters of this volume. It is of interest, however, to show in one table the total tonnage of limestone used for all purposes.

*Limestone used for all purposes in the United States, 1936–38, in short tons*

| Use | 1936 | 1937 | 1938 |
|---|---|---|---|
| Limestone (as given in this report) (approximate) | 87,736,000 | 94,577,000 | 81,514,000 |
| Portland cement (including "cement rock") [1] | 28,650,000 | 29,547,000 | 26,183,000 |
| Natural cement ("cement rock") [1] | | | |
| Lime [2] | 7,500,000 | 8,250,000 | 6,694,000 |
| | 123,886,000 | 132,374,000 | 114,391,000 |

[1] Value reported as cement in the chapter on Cement.
[2] Value reported as lime in the chapter on Lime.

## SANDSTONE

The sandstone industry, which suffered a serious set-back in 1937, recovered remarkably in 1938. Sales increased 27 percent in quantity and 14 percent in value. Because of reduced activity in steel plants sales of refractory stone (ganister) declined greatly, but the output of riprap and stone for highway use and concrete aggregate made large gains.

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*Sandstone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Refractory stone (ganister) | | Riprap | | Crushed stone | | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Concrete and road metal | | Railroad ballast | | | | | |
| | | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 10 | (1) | (1) | | | (1) | (1) | | | | | 114,690 | $100,396 |
| Arizona | 1 | | | (1) | (1) | | | | | | | (1) | (1) |
| Arkansas | 9 | | | | | 193,510 | $151,553 | | | | | 193,510 | 151,553 |
| California | 19 | (1) | (1) | 49,240 | $34,463 | 476,170 | 413,280 | (1) | (1) | (1) | (1) | 699,460 | 577,093 |
| Colorado | 20 | 4,790 | $7,492 | 4,730 | 2,134 | 123,380 | 135,172 | | | | | 132,900 | 144,798 |
| Georgia | 1 | | | | | (1) | (1) | | | | | (1) | (1) |
| Idaho | 1 | | | | | (1) | (1) | | | | | (1) | (1) |
| Illinois | 2 | (1) | (1) | | | (1) | (1) | | | | | (1) | (1) |
| Indiana | 8 | | | | | 26,080 | 24,831 | | | | | 26,080 | 24,831 |
| Iowa | 1 | | | | | (1) | (1) | | | | | (1) | (1) |
| Kansas | 20 | | | 1,250 | 1,000 | 162,850 | 221,646 | | | | | 164,100 | 222,646 |
| Kentucky | 1 | (1) | (1) | | | | | | | | | (1) | (1) |
| Maryland | 1 | | | | | (1) | (1) | | | | | (1) | (1) |
| Michigan | 3 | | | | | 31,490 | 31,867 | | | | | 31,490 | 31,867 |
| Minnesota | 2 | | | (1) | (1) | (1) | (1) | | | | | (1) | (1) |
| Montana | 2 | (1) | (1) | (1) | (1) | | | | | | | (1) | (1) |
| New Mexico | 1 | | | | | | | (1) | (1) | | | (1) | (1) |
| New York | 33 | (1) | (1) | 15,530 | 5,272 | 236,840 | 217,181 | | | (1) | (1) | 257,500 | 229,303 |
| North Carolina | 3 | | | | | 605,720 | 748,895 | | | | | 605,720 | 748,895 |
| Ohio | 27 | 17,060 | 101,864 | 50,030 | 67,196 | 265,160 | 211,848 | | | 240 | $611 | 332,490 | 381,519 |
| Oklahoma | 7 | | | | | 10,290 | 14,774 | | | | | 10,290 | 14,774 |
| Oregon | 6 | | | (1) | (1) | (1) | (1) | | | | | 283,190 | 308,586 |
| Pennsylvania | 47 | 187,770 | 283,855 | 35,890 | 40,589 | 482,620 | 525,916 | 95,430 | $89,856 | 10,670 | 14,010 | 812,380 | 954,226 |
| South Dakota | 6 | | | (1) | (1) | 58,030 | 77,294 | | | (1) | (1) | 132,540 | 136,863 |
| Tennessee | 2 | | | | | 36,060 | 37,459 | | | | | 36,060 | 37,459 |
| Texas | 8 | | | (1) | (1) | 89,090 | 59,243 | (1) | (1) | | | 114,360 | 77,456 |
| Utah | 7 | 7,010 | 14,016 | | | 416,540 | 192,711 | | | | | 423,550 | 206,727 |
| Vermont | 17 | | | | | 28,920 | 26,389 | | | | | 28,920 | 26,389 |
| Virginia | 25 | | | | | 202,030 | 217,597 | 22,940 | 14,323 | 9,590 | 3,350 | 234,560 | 235,270 |
| Washington | 1 | | | 650 | 460 | | | | | 250 | 768 | 900 | 1,228 |
| West Virginia | 139 | (1) | (1) | (1) | (1) | 905,910 | 1,299,753 | | | | | 983,880 | 1,360,741 |
| Wisconsin | 9 | 67,790 | 97,186 | 8,650 | 8,650 | 1,470 | 3,159 | | | 133,830 | 334,131 | 211,740 | 443,126 |
| Wyoming | 1 | | | | | (1) | (1) | | | | | (1) | (1) |
| Undistributed | | 96,690 | 100,697 | 431,080 | 384,674 | 278,630 | 179,327 | 96,090 | 81,468 | 170,320 | 114,563 | 318,000 | 176,777 |
| | 440 | 381,110 | 605,110 | 597,050 | 544,438 | 4,630,790 | 4,789,895 | 214,460 | 185,647 | 324,900 | 467,433 | 6,148,310 | 6,592,523 |

[1] Included under "Undistributed."

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## MISCELLANEOUS STONE

Stone other than the five principal varieties already discussed includes light-colored volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows production of such types of stone by uses in 1938.

*Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses*

| State | Active plants | Riprap | | Crushed stone | | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Short tons | Value | Concrete and road metal | | Railroad ballast | | Short tons | Value | Short tons | Value |
| | | | | Short tons | Value | Short tons | Value | | | | |
| Alabama | 2 | | | (1) | (1) | | | | | (1) | (1) |
| Alaska | 10 | | | 125,310 | $143,571 | | | | | 125,310 | $143,571 |
| Arizona | 11 | | | 336,070 | 241,353 | | | | | 336,070 | 241,353 |
| Arkansas | 2 | (1) | (1) | (1) | (1) | (1) | (1) | | | (1) | (1) |
| California | 83 | 133,610 | $151,340 | 3,956,190 | 2,653,960 | 148,210 | $62,420 | 9,570 | $49,998 | 4,247,580 | 2,917,718 |
| Colorado | 8 | 100 | 200 | 198,760 | 150,398 | | | | | 198,860 | 150,598 |
| Florida | 3 | | | 31,060 | 68,520 | | | | | 31,060 | 68,520 |
| Georgia | 13 | | | 13,290 | 19,711 | | | | | 13,290 | 19,711 |
| Hawaii | 2 | | | (1) | (1) | | | | | (1) | (1) |
| Idaho | 2 | | | (1) | (1) | | | | | (1) | (1) |
| Illinois | 1 | | | 38,590 | 16,013 | | | | | 38,590 | 16,013 |
| Indiana | 4 | | | 17,380 | 18,401 | | | | | 17,380 | 18,401 |
| Iowa | 1 | | | (1) | (1) | | | | | (1) | (1) |
| Kansas | 3 | (1) | (1) | (1) | (1) | | | | | 20,450 | 32,260 |
| Maine | 5 | | | 23,280 | 43,282 | | | | | 23,280 | 43,282 |
| Maryland | 4 | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | 127,680 | 132,705 |
| Massachusetts | 4 | (1) | (1) | (1) | (1) | | | | | 275,770 | 375,915 |
| Michigan | 9 | 113,900 | 113,639 | 95,570 | 98,941 | | | 6,730 | 52,901 | 216,200 | 265,481 |
| Minnesota | 2 | | | (1) | (1) | | | | | (1) | (1) |
| Missouri | 4 | (1) | (1) | (1) | (1) | | | (1) | (1) | 13,430 | 19,349 |
| Montana | 4 | | | 75,890 | 51,045 | | | | | 75,890 | 51,045 |
| Nevada | 8 | 54,370 | 31,412 | 31,390 | 54,726 | | | 196,130 | 81,938 | 281,890 | 168,076 |
| New Hampshire | 2 | | | 1,750 | 2,748 | | | 3,260 | 23,786 | 5,010 | 26,534 |
| New Jersey | 4 | | | (1) | (1) | | | (1) | (1) | 87,700 | 91,823 |
| New Mexico | 7 | | | 432,400 | 241,469 | | | | | 432,400 | 241,469 |
| New York | 5 | | | (1) | (1) | | | (1) | (1) | 215,730 | 134,411 |
| North Carolina | 35 | | | 593,720 | 536,691 | | | | | 593,720 | 536,691 |
| North Dakota | 8 | | | 20,090 | 5,395 | | | | | 20,090 | 5,395 |
| Ohio | 2 | | | (1) | (1) | | | (1) | (1) | (1) | (1) |
| Oklahoma | 7 | (1) | (1) | (1) | (1) | (1) | (1) | | | 70,330 | 38,853 |
| Oregon | 6 | (1) | (1) | (1) | (1) | | | | | 124,430 | 92,125 |
| Pennsylvania | 73 | 5,900 | 5,310 | 2,160,400 | 1,605,800 | | | 38,670 | 288,938 | 2,204,970 | 1,900,048 |

[1] Included under "Undistributed."

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*Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses*—Continued

| State | Active plants | Riprap | | Crushed stone | | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Short tons | Value | Concrete and road metal | | Railroad ballast | | Short tons | Value | Short tons | Value |
| | | | | Short tons | Value | Short tons | Value | | | | |
| Puerto Rico | 9 | | | (1) | (1) | (1) | (1) | | | 88,700 | $79,854 |
| Rhode Island | 6 | | | 185,220 | $276,370 | | | | | 185,220 | 276,370 |
| South Carolina | 4 | | | 2,330 | 2,330 | | | | | 2,330 | 2,330 |
| South Dakota | 21 | 310 | $310 | 67,860 | 50,289 | | | | | 68,170 | 50,599 |
| Tennessee | 5 | | | 21,640 | 16,748 | | | | | 21,640 | 16,748 |
| Texas | 14 | (1) | (1) | 975,860 | 712,015 | (1) | (1) | (1) | (1) | 1,016,470 | 741,189 |
| Utah | 5 | | | (1) | (1) | | | (1) | (1) | 40,460 | 22,424 |
| Vermont | 30 | | | 113,040 | 104,663 | | | | | 113,040 | 104,663 |
| Virginia | 17 | | | (1) | (1) | | | (1) | (1) | 206,210 | 294,355 |
| Washington | 5 | | | (1) | (1) | | | (1) | (1) | 43,730 | 38,727 |
| West Virginia | 2 | | | (1) | (1) | | | | | (1) | (1) |
| Wisconsin | 11 | (1) | (1) | (1) | (1) | | | | | 96,770 | 73,910 |
| Wyoming | 2 | | | (1) | (1) | | | | | (1) | (1) |
| Undistributed | | 97,320 | 83,762 | 1,557,180 | 1,511,009 | 267,780 | $184,458 | 21,090 | $107,356 | 491,370 | 430,700 |
| | 465 | 405,510 | 385,973 | 11,074,270 | 8,625,448 | 415,990 | 246,878 | 275,450 | 604,917 | 12,171,220 | 9,863,216 |

[1] Included under "Undistributed."

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## MARKETS

The consumption of concrete aggregates and roadstone ordinarily bears a fairly definite relationship to portland-cement shipments, area of new concrete pavements, and total building construction; but, as shown graphically in figure 3, aggregates made a much better showing in 1938 than the others. The commercial producer was not as fortunate as the chart would indicate, because the gain was in

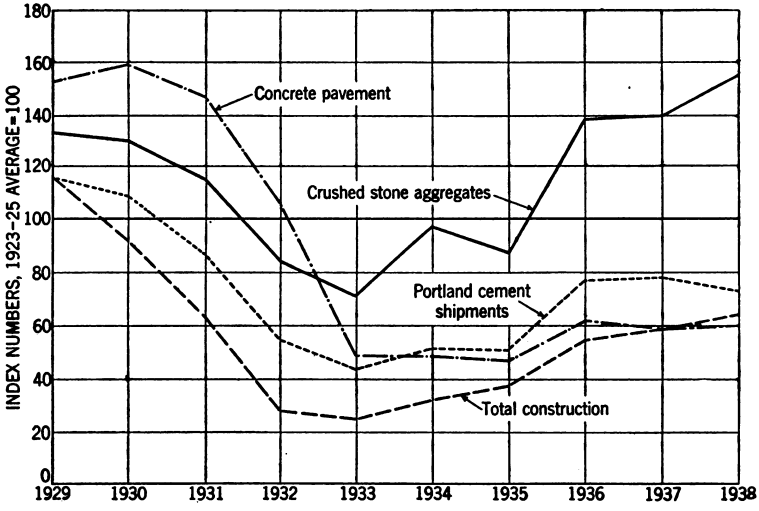


FIGURE 3.—Sales of crushed-stone aggregates (tons) compared with total construction, portland-cement shipments, and contracts for concrete pavements 1929–38. Data are plotted as index numbers with the 1923–25 average as 100. Figures on concrete pavements compiled by Portland Cement Association and on construction contracts by F. W. Dodge Corporation.

noncommercial production. Commercial production declined 3 percent in 1938, whereas noncommercial production increased 32 percent. The most logical explanation for the disproportionate increase in production of aggregates seems to be the fact that a large part of the stone produced at noncommercial quarries is employed on secondary roads and in other ways that have little connection with the other elements in figure 3.

Limestone is used extensively as a flux in blast furnaces producing pig iron and to a smaller extent in certain other smelting operations. Therefore a close relationship is to be expected between production of pig iron and sales of fluxing stone. Figure 4 shows the remarkable parallelism between these two industrial activities.

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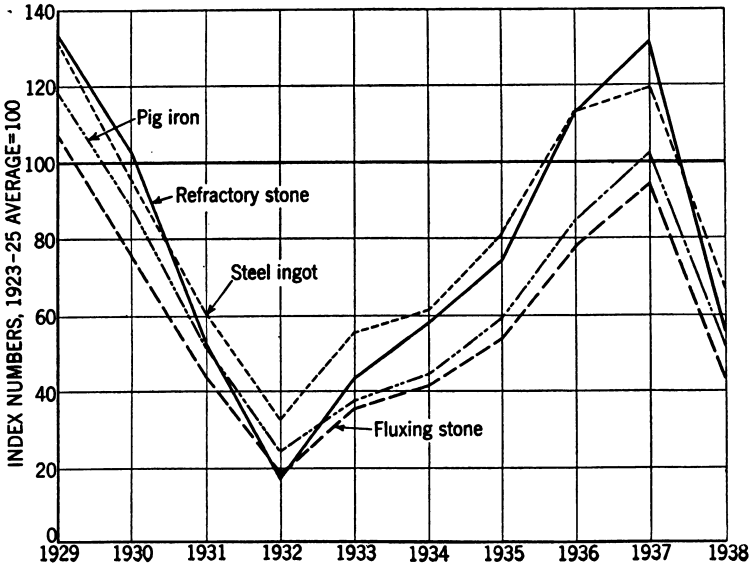


FIGURE 4.—Sales of fluxing stone and refractory stone (tons) compared with production of steel ingot and pig iron, 1929-38. All data are plotted as index numbers, with the 1923-25 average as 100. Statistics of steel-ingot and pig-iron production compiled by American Iron and Steel Institute.

Large quantities of dolomite and ganister are used as refractories in steel furnaces. Consumption of these products therefore fluctuates more or less in consonance with the changing pace of steel ingot production. Furnace relining is more active in some years than others, therefore the curves for steel ingot and refractory stone agree less closely than those for pig iron and fluxing stone.

## NEW DEVELOPMENTS

*Plants.*—The current trend toward the use of smaller stone in concrete mixtures has led to the installation of additional crushers and supplementary equipment at many crushed-stone plants. New grinding and screening equipment has been added at several plants to provide for a growing market for agricultural limestone.

A record of new crushing plants and remodeling of existing plants during 1938 may be found in the technical press.[3]

*Products.*—Stone sand is being used more widely as a substitute for silica sand as fine aggregate in concrete. Success in marketing this product can be expected principally where natural sand is not readily available. The grains must have proper shape and proper gradation; cubic or rounded particles are better than flat grains, and a lean concrete requires finer sand than a rich concrete. Stone sand is becoming an important byproduct at several limestone, dolomite, and granite quarries.

[3] Pit and Quarry, The Crushed-stone Industry in 1938: Vol. 31, Jan. 1939, pp. 91-97.

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## FOREIGN TRADE [4]

*Imports.*—Foreign trade in stone is confined chiefly to dimension stone, but imports of quartzite from Canada are becoming increasingly important. Total imports in 1938 decreased 15 percent in value from 1937. The following table shows the quantities and values imported in 1938, by kinds. Imports of marble and rough granite declined greatly, but imports of dressed granite and miscellaneous stone products rose substantially, and those of travertine more than doubled. As indicated in the table of imports by countries of origin, imports of onyx marble from Mexico were smaller in 1938 than in 1937, while those from Argentina were larger in quantity but much smaller in value.

*Stone imported for consumption in the United States in 1938, by classes*

| Class | Quantity | Value | Class | Quantity | Value |
|---|---|---|---|---|---|
| Marble, breccia, and onyx: | | | Quartzite, short tons | 109,403 | $224,738 |
| In blocks, rough, etc., cubic feet | 54,582 | $197,284 | | | |
| Sawed, do | 170 | 873 | Travertine stone: Rough, cubic feet | 29,641 | 32,313 |
| Slabs or paving tiles, superficial feet | 177,125 | 55,585 | | | |
| All other manufactures | | 47,215 | Stone (other): | | |
| Mosaic cubes of marble or onyx: | | | Dressed | | 1,510 |
| Loose, pounds | 39,478 | 714 | Rough (monumental or building stone), cubic feet | 3,000 | 6,831 |
| | | | Rough (other), short tons | 9,684 | 21,882 |
| | | 301,671 | | | |
| Granite: | | | | | 30,223 |
| Dressed, cubic feet | 40,891 | 200,243 | | | |
| Rough, do | 30,523 | 49,330 | Grand total | | 838,518 |
| | 71,414 | 249,573 | | | |

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Stone imported for consumption in the United States in 1938, by classes and countries*

| Country | Marble, breccia, and onyx | | | Granite | | Other building or monumental stone (value) | Other stone, n. e. s. (value) | Quartzite | | Travertine | | Total value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rough | | Manufactures (value) | Cubic feet | Value | | | Short tons | Value | Cubic feet | Value | |
| | Cubic feet | Value | | | | | | | | | | |
| North America: | | | | | | | | | | | | |
| Canada | 231 | $1,374 | $130 | 2,919 | $3,482 | $240 | $15,099 | 109,061 | $199,864 | | | $220,189 |
| Cuba | 26 | 13 | 865 | | | 9 | | | | | | 887 |
| Mexico | 10,443 | 43,940 | 327 | | | | | | | | | 44,267 |
| Total North America | 10,700 | 45,327 | 1,322 | 2,919 | 3,482 | 249 | 15,099 | 109,061 | 199,864 | | | 265,343 |
| South America: | | | | | | | | | | | | |
| Argentina | 3,558 | 56,030 | 401 | | | | | | | | | 56,431 |
| Brazil | 9 | 60 | | | | | | | | | | 60 |
| Other South America | 61 | 850 | 27 | | | | | | | | | 877 |
| Total South America | 3,628 | 56,940 | 428 | | | | | | | | | 57,368 |
| Europe: | | | | | | | | | | | | |
| Belgium | 9,665 | 24,464 | 16,548 | | | | | | | | | 41,012 |
| Czechoslovakia | | | | 202 | 1,765 | | | | | | | 1,765 |
| Finland | | | 30 | 55,116 | 214,365 | | | | | | | 214,395 |
| France | 3,830 | 8,999 | 10,047 | | | 788 | | | | | | 19,834 |
| Germany | | | 496 | 16 | 189 | | | | | | | 685 |
| Italy | 24,275 | 53,862 | 62,822 | 10 | 99 | 1,004 | | | | 29,641 | $32,313 | 150,100 |
| Sweden | 374 | 1,697 | | 12,178 | 26,490 | | | 29 | 669 | | | 28,856 |
| United Kingdom | 316 | 1,689 | 2,487 | 223 | 1,156 | 367 | 6,773 | | | | | 12,472 |
| Other Europe | 1,770 | 4,103 | 1,230 | 699 | 1,767 | 285 | | 303 | 24,129 | | | 31,514 |
| Total Europe | 40,230 | 94,814 | 93,660 | 68,444 | 245,831 | 2,444 | 6,773 | 332 | 24,798 | 29,641 | 32,313 | 500,633 |
| Asia: | | | | | | | | | | | | |
| China | | | 582 | | | 204 | | | | | | 786 |
| India, British | 10 | 106 | 8,264 | | | 10 | | | | | | 8,380 |
| Other Asia | | | 131 | 51 | 260 | 226 | 10 | 10 | 76 | | | 703 |
| Total Asia | 10 | 106 | 8,977 | 51 | 260 | 440 | 10 | 10 | 76 | | | 9,869 |
| Africa | 14 | 97 | | | | 5,208 | | | | | | 5,305 |
| Grand total | 54,582 | 197,284 | 104,387 | 71,414 | 249,573 | 8,341 | 21,882 | 109,403 | 224,738 | 29,641 | 32,313 | 838,518 |

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*Exports.*—The export trade in stone is relatively small, and most of it is with Canada. The following table of exports appears in a new form because the export classification has been changed to combine marble with other building and monumental stone.

*Stone exported from the United States in 1938, by countries*

| Country | Marble and other building and monumental stone | | Other manufactures of stone (value) | Country | Marble and other building and monumental stone | | Other manufactures of stone (value) |
|---|---|---|---|---|---|---|---|
| | Cubic feet | Value | | | Cubic feet | Value | |
| Canada | 72,398 | $111,644 | $145,003 | United Kingdom | 778 | $1,891 | $11,967 |
| Cuba | 1,438 | 6,083 | 19,224 | Other countries | 2,182 | 14,964 | 64,728 |
| Germany | 455 | 830 | 10,643 | | 78,374 | 141,815 | 282,422 |
| Mexico | 1 | 53 | 17,398 | | | | |
| Netherland India | | | 12,952 | | | | |
| Newfoundland and Labrador | 1,122 | 6,350 | 507 | | | | |

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# SLATE

By Oliver Bowles and M. Schauble

## SUMMARY OUTLINE


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From the low point of the depression in 1933 the slate industry made steady gains until 1938 but suffered a severe setback in that year. The quantity of slate sold as dimension stone in 1938 dropped 14 percent and the value 21 percent compared with 1937. The substantial drop in prices per unit is noteworthy. If the reduced price is a measure of lower costs of production it may imply a more favorable competitive position for slate, but if it represents reduction of inventories and price cutting to levels approaching or lower than cost of production—a condition that has obtained in the slate industry repeatedly—one must infer that 1938 was in general an unprofitable year.

Roofing-slate sales declined relatively more in value than in quantity. The average value per square in 1938 was $6.98, whereas in 1937 it was $7.46. Sales in the Pennsylvania district dropped 11 percent in quantity and 17 percent in value compared with 1937. In the New York-Vermont district the quantity sold dropped 20 percent and the value 28 percent. In Virginia, however, sales increased 5 percent in quantity and 6 percent in value. The more favorable condition of the Virginia industry probably was due to the active residential building that characterized Washington, D. C., and its vicinity during 1938.

Sales of millstock declined 15 percent in quantity and 30 percent in value compared with 1937. Although building construction advanced from 59 percent of the 1923–25 average in 1937 to 64 percent in 1938, sales of structural and sanitary slate dropped 14 percent in quantity and 24 percent in value. Evidently slate is being replaced by other structural materials. The greatest decline experienced by any major branch of the slate industry was that of electrical slate, which dropped 63 percent in both quantity and value. Although high-grade slate is regarded as of superior quality for electrical panels and switchboards, it is apparent that various synthetic dielectric materials are being used to an increasing extent. Blackboards and bulletin boards maintained their position very well, for sales were off



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only 1 percent in quantity and 3 percent in value. Billiard-table tops, which represent a relatively unimportant branch of the industry, made large gains in 1938. Sales of school slates decreased in quantity but gained in value. Sales of slate for vaults and covers and for flagging, cross walks, and stepping stones slumped greatly. Granules and flour, which have little connection with the slate industry, appear in the table because they are manufactured from slate, although much of the material so used is derived from deposits that could not be utilized for dimension-slate products. Granule sales made large gains in 1938, and the value per ton was $1.43 higher than in 1937.

The following table giving the principal statistical data for the slate industry during 1937 and 1938 is arranged to permit ready comparison for the 2 years:

*Salient statistics of the slate industry in the United States, 1937–38*

| | 1937 | | | 1938 | | | | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | | Value | Quantity | | Value | Percent of change in— | |
| | Unit of measurement | Approximate equivalent short tons | | Unit of measurement | Approximate equivalent short tons | | Quantity (unit as reported) | Value |
| Domestic production (sales by producers): | | | | | | | | |
| Roofing slate | *Squares* 365,800 | 187,400 | $2,728,109 | *Squares* 322,040 | 119,590 | $2,247,910 | −12.0 | −17.6 |
| Millstock: | *Sq. ft.* | | | *Sq. ft.* | | | | |
| Electrical slate | 594,660 | 5,140 | 444,887 | 221,140 | 1,830 | 162,793 | −62.8 | −63.4 |
| Structural and sanitary slate | 997,860 | 8,080 | 322,974 | 861,520 | 7,220 | 245,741 | −13.7 | −23.9 |
| Grave vaults and covers | 324,680 | 2,940 | 73,017 | 274,640 | 2,070 | 64,821 | −15.4 | −11.2 |
| Blackboards and bulletin boards | 1,651,010 | 4,400 | 357,043 | 1,637,570 | 4,220 | 347,486 | −.8 | −2.7 |
| Billiard-table tops | 47,020 | 350 | 15,794 | 60,150 | 440 | 19,582 | +27.9 | +24.0 |
| School slates | [1] 578,930 | 570 | 11,930 | [1] 520,200 | 530 | 13,179 | −10.1 | +10.5 |
| Total millstock | 4,194,160 | 21,480 | 1,225,645 | 3,575,220 | 16,310 | 853,602 | −14.8 | −30.4 |
| Flagstones, etc.[2] | 1,215,490 | 8,670 | 73,554 | 1,046,530 | 7,790 | 63,839 | −13.9 | −13.2 |
| Total slate as dimension stone | | 167,550 | 4,027,308 | | 143,690 | 3,165,351 | −14.2 | −21.4 |
| Granules and flour | | 277,010 | 1,578,014 | | 349,000 | 2,489,962 | +26.0 | +57.8 |
| Grand total domestic production | | 444,560 | 5,605,322 | | 492,690 | 5,655,313 | +10.8 | +.9 |
| Foreign trade: | | | | | | | | |
| Imports for consumption | | | 4,824 | | | 6,688 | | +38.6 |
| Exports:[3] | | | | | | | | |
| Roofing | 1,025 | | 9,382 | 660 | | 5,070 | −35.6 | −46.0 |
| Other dimension slate | | | 65,193 | | | 58,852 | | −9.7 |
| Granules and flour | | 11,184 | 77,576 | | 11,229 | 93,675 | +.4 | +20.8 |

[1] 1937, 1,083,600 pieces; 1938, 972,780 pieces; square feet approximate.
[2] Includes walkways, stepping stones, and miscellaneous slate.
[3] Figures obtained by the Bureau of Mines from shippers.

## SALES

*Dimension slate.*—The following table shows sales of dimension slate in recent years—that is, all slate sold in blocks or slabs cut to specified sizes and shapes. Such a classification excludes granules and flour.

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*Slate (other than granules and flour) sold by producers in the United States, 1934–38*

| Year | Roofing | | | Millstock | | Other [1] | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | Squares | Approximate equivalent short tons | Value | Approximate short tons | Value | Approximate short tons | Value | Approximate short tons | Value |
| 1934 | 137,010 | 51,640 | $1,033,164 | 11,580 | $581,959 | 3,350 | $26,705 | 66,570 | $1,641,828 |
| 1935 | 221,630 | 83,290 | 1,456,041 | 15,580 | 849,796 | 4,820 | 35,333 | 103,690 | 2,341,170 |
| 1936 | 336,130 | 138,190 | 2,607,402 | 20,100 | 1,175,668 | 6,820 | 55,358 | 165,110 | 3,838,428 |
| 1937 | 365,800 | 137,400 | 2,728,109 | 21,480 | 1,225,645 | 8,670 | 73,554 | 167,550 | 4,027,308 |
| 1938 | 322,040 | 119,590 | 2,247,910 | 16,310 | 853,602 | 7,790 | 63,839 | 143,690 | 3,165,351 |

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Figure 1 compares sales of slate, except granules and flour, with the value of contracts awarded for residential building and total building from 1929 to 1938. Slate sales followed closely the trends in building construction until 1938, but in that year slate experienced a radical decline.

*Granules and flour.*—Slate granules are used quite extensively for surfacing prepared roofing, and slate flour is employed as a filler in roofing mastic, linoleum, and other products. The following table shows sales of granules and flour by producers from 1934 to 1938:

*Crushed slate (granules and flour) sold by producers in the United States, 1934–38*

| Year | Granules | | Flour | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 123,290 | $902,078 | 42,870 | $164,022 | 166,160 | $1,066,100 |
| 1935 | 166,520 | 1,112,081 | 59,990 | 196,264 | 226,510 | 1,308,345 |
| 1936 | 202,730 | 1,372,095 | 86,920 | 274,685 | 289,650 | 1,646,780 |
| 1937 | 193,950 | 1,309,549 | 83,060 | 268,465 | 277,010 | 1,578,014 |
| 1938 | 258,930 | 2,220,306 | 90,070 | 269,656 | 349,000 | 2,489,962 |

*Trends in roofing slate.*—Residential building is the principal market for roofing slate. Slate is used for new construction and reroofing, but no figures are available as to the proportion used for each. New construction is, however, the principal market. No statistics are available on the roof area of new residential construction; but roof area bears a fairly definite relation to floor space, for which data are compiled. Floor space may therefore be regarded as a rough index of the area covered with roofing.

Figure 2 compares sales of roofing slate in squares with residential floor space of new construction from 1929 to 1938. The chart indicates that slate did not suffer as severe a recession as residential building from 1929 to 1934 and that in 1935 and 1936 slate sales gained more rapidly than construction contracts; however, in 1937 slate sales dropped slightly, and in 1938 they experienced a sharp decline, although floor space of new residential construction made moderate gains during these years.

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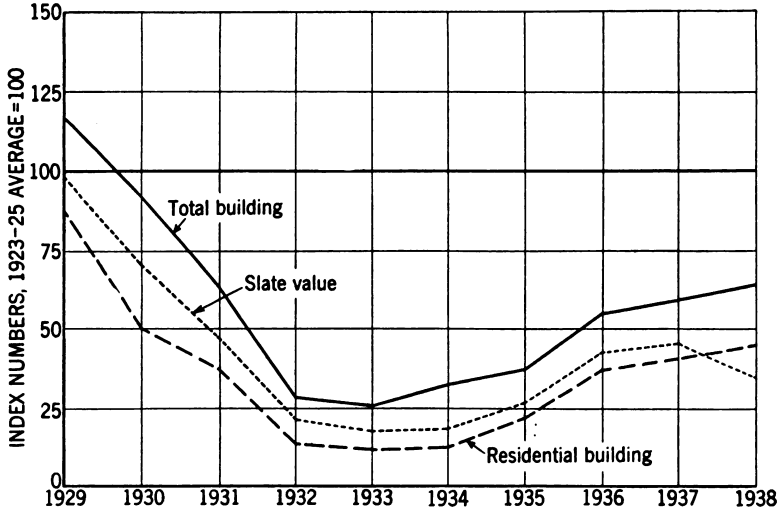


FIGURE 1.—Sales of slate compared with residential building and total building, 1929-38. Data on building from the F. W. Dodge Corporation.

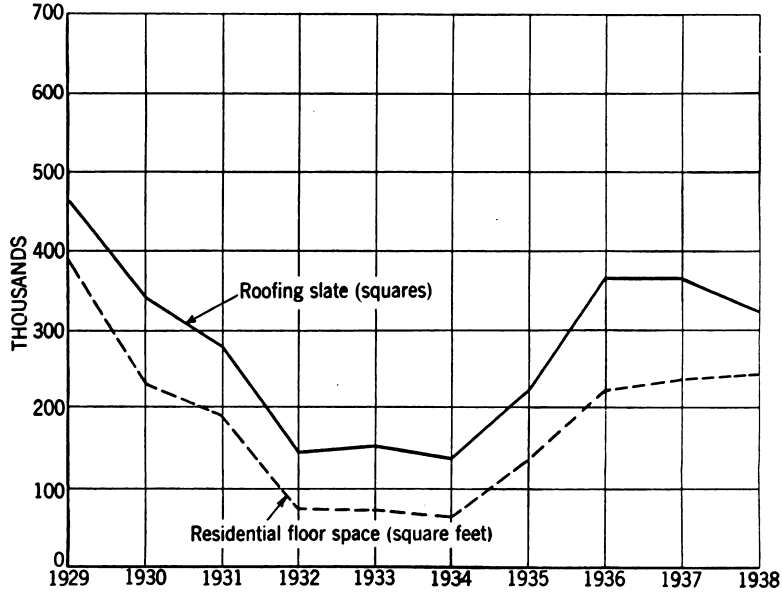


FIGURE 2.—Sales of roofing slate compared with residential floor space, 1929-38. Statistics on floor space from the F. W. Dodge Corporation.

## PRICES

Prices of roofing slate f. o. b. quarry or mill, as reported to the Bureau of Mines by producers, declined 48 cents a square in 1938 compared with 1937. In Pennsylvania the price dropped 50 cents a square; in the New York-Vermont area, 75 cents; but in Virginia the price advanced 8 cents a square.

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Average millstock prices fell from 29 cents a square foot in 1937 to 24 cents in 1938. Blackboards, bulletin boards, and electrical slate sold at 1 cent a square foot less than in 1937. Structural and sanitary slate fell 3 cents a square foot; vaults and covers advanced 2 cents, and school slates were a little higher than in 1937.

*Trends in recent years.*—Figure 3 shows the trend of slate prices over a 10-year period compared with prices of building materials in

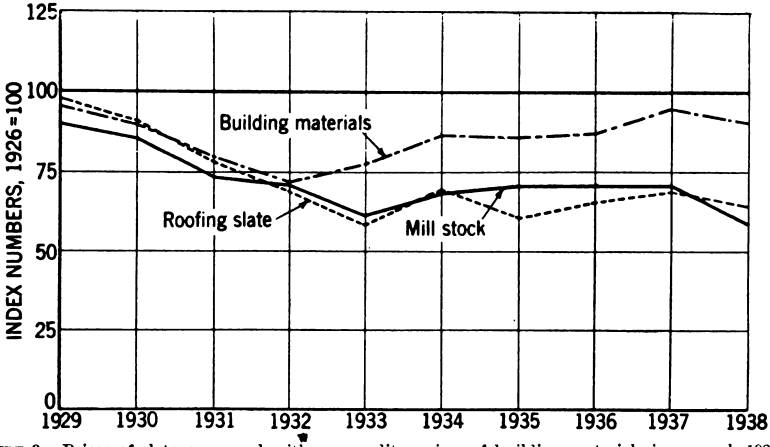


FIGURE 3.—Prices of slate compared with commodity prices of building materials in general, 1929-38. Commodity prices are from the Bureau of Labor Statistics.

general. The drop in price of roofing slate was comparable with that of building materials, but millstock prices fell abnormally.

## REVIEW BY STATES AND DISTRICTS

The following table shows sales of slate in 1938 by States and uses:

*Slate sold by producers in the United States in 1938, by States and uses*

| State | Operators | Roofing | | Millstock | | Other uses [1] (value) | Total value |
|---|---|---|---|---|---|---|---|
| | | Squares (100 square feet) | Value | Square feet | Value | | |
| Arkansas | 1 | | | | | (2) | (2) |
| California | 3 | | | | | $27,877 | $27,877 |
| Georgia | 1 | | | | | (2) | (2) |
| Maine | 2 | (2) | (2) | (2) | (2) | (2) | (2) |
| Maryland | 1 | | | | | (2) | (2) |
| New York | 17 | 2,780 | $26,340 | (2) | (2) | [3] 418,991 | 445,331 |
| Pennsylvania | 30 | 195,560 | 1,293,426 | 3,292,330 | $664,006 | 544,045 | 2,501,477 |
| Tennessee | 2 | (2) | (2) | (2) | (2) | (2) | (2) |
| Vermont | 51 | 83,490 | 577,279 | 135,750 | 68,279 | 1,084,097 | 1,729,655 |
| Virginia | 5 | 34,440 | 300,527 | | | 68,533 | 369,060 |
| Undistributed [4] | | 5,770 | 50,338 | 147,140 | 121,317 | 410,258 | 581,913 |
| | 113 | 322,040 | 2,247,910 | 3,575,220 | 853,602 | 2,553,801 | 5,655,313 |

[1] Flagging and similar products, granules, and flour.
[2] Included under "Undistributed."
[3] A small amount of millstock included under "Other uses."
[4] Includes output of States entered as "(2)" above.

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*Maine.*—The principal product of the Maine quarries is electrical slate, the production of which suffered the most serious decline in its history. The Rising & Nelson Slate Co. has discontinued its operations in Maine.

*New York-Vermont.*—The slate area on the New York-Vermont border furnishes attractive green, purple, mottled, and red roofing slates, but sales of these products dropped sharply in 1938. Sales of millstock were only about half as large as in 1937, but sales of granules and flour made decisive gains. The value of all slate products sold in Vermont in 1938 was 21 percent greater than in 1937, the increase in granule sales more than compensating for the drastic decline in other products.

*Peach Bottom district.*—The chief output of the Peach Bottom district on the Maryland-Pennsylvania border is granules, but excellent roofing slate is available. At present the Funkhouser Co. is the only producer of roofing slate in this area.

*Lehigh district.*—The Lehigh district, comprising Lehigh and Northampton Counties, Pa., is the most productive slate area in the United States and furnishes all types of slate products. As separate figures cannot be shown for York County, it is included with Northampton County in the table.

*Slate sold by producers in Pennsylvania in 1938, by counties and uses*

| County | Operators | Roofing slate | | Millstock [1] | | | |
|---|---|---|---|---|---|---|---|
| | | Squares (100 square feet) | Value | Electrical | | Structural and sanitary [2] | |
| | | | | Square feet | Value | Square feet | Value |
| Lehigh | 10 | 11,850 | $80,363 | 16,590 | $6,989 | 24,970 | $5,871 |
| Northampton and York [3] | 20 | 183,710 | 1,213,063 | 4,820 | 3,094 | 1,028,030 | 267,805 |
| | 30 | 195,560 | 1,293,426 | 21,410 | 10,083 | 1,053,000 | 273,676 |

| County | Millstock—Continued [1] | | | | Other uses (value) [4] | Total value |
|---|---|---|---|---|---|---|
| | Blackboards and bulletin boards | | School slates | | | |
| | Square feet | Value | Square feet | Value | | |
| Lehigh | 414,780 | $93,030 | [5] 520,200 | [5] $13,179 | ([6]) | [5] [6] $199,432 |
| Northampton and York [3] | 1,222,790 | 254,456 | ([5]) | ([5]) | [6] $563,627 | [5] [6] 2,302,045 |
| | 1,637,570 | 347,486 | 520,200 | 13,179 | 563,627 | 2,501,477 |

[1] Exclusive of billiard-table material, value of which is included under "Other uses."
[2] Includes slate for grave covers and vaults.
[3] York County produced roofing slate, granules, and flour only.
[4] Includes 60,150 square feet of billiard-table material valued at $19,582.
[5] Small amount of school slates produced in Northampton County included under Lehigh County.
[6] Small amount of flagging produced in Lehigh County included under Northampton and York Counties.

Sales of roofing slate in 1938 in the Lehigh district (and York County) decreased 11 percent in quantity and 17 percent in value from those in 1937. Electrical slate sales were only about one-third as great as in 1937, while structural and sanitary products and school slates exhibited a moderate decline. Sales of blackboards and bulletin boards were nearly as great as in 1937. Sales of billiard-

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table material and granules alone gained in 1938. The value of total sales of slate products was 9 percent less in 1938 than in 1937.

*Virginia.*—The slate industry of Buckingham County is devoted chiefly to the production of roofing slate. Sales achieved a moderate gain with average prices a little higher than in 1938.

*Other districts.*—Arkansas, California, Georgia, and Tennessee reported a small output, chiefly of granules and flagging. The Maryland Slate Corporation, Silver Spring, Md., is reopening a quarry that was operated in a small way many years ago in Frederick County, Md. The principal product will be blue-black roofing slate similar to that obtained in the Peach Bottom district.

## NEW DEVELOPMENTS

Investigations by the Building Research Station of the Department of Scientific and Industrial Research, London, England, conducted a few years ago, indicated that when slate is calcined at a high temperature it is converted into a light, spongy mass that will float on water. Similar results were obtained by the Eastern Experiment Station of the Bureau of Mines by calcining Pennsylvania slate. If a satisfactory commercial product can be made, a market may be developed for waste slate in the form of light-weight aggregate.

A detailed discussion of the domestic and foreign slate industries has recently appeared.[1]

## FOREIGN TRADE[2]

*Imports.*—The value of slate imported for consumption in the United States in 1938 was 39 percent greater than in 1937, but imports are relatively unimportant. The following table shows the value of imports in 1937 and 1938 by countries:

*Slate imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | 1938 | Country | 1937 | 1938 |
|---|---|---|---|---|---|
| Canada | $826 | $543 | Italy | $349 | $994 |
| China | | 3 | Japan | 222 | 68 |
| Czechoslovakia | 990 | 1,037 | Norway | 381 | |
| France | | 895 | United Kingdom | 2,019 | 3,089 |
| Germany | 17 | | | | |
| Hong Kong | 20 | 59 | | 4,824 | 6,688 |

*Exports.*—In 1936 and following years exports of roofing slate were included with exports of stone in the tabulations of the Bureau of Foreign and Domestic Commerce; therefore separate figures from that source cannot be given. The following table shows exports of slate products from 1936 to 1938, as reported to the Bureau of Mines by shippers. Roofing, electrical, billiard tables, and structural slate exports show large declines; school slates, a moderate gain; and blackboards, a large gain. Slate granules and flour evidence a small gain in quantity and a larger gain in value.

[1] Bowles, Oliver, The Stone Industries, 2d ed.: McGraw-Hill Book Co., Inc., New York, 1939, 519 pp.

[2] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Slate exported from the United States, 1936–38, by uses* [1]

| Use | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value |
| Roofing----------squares-- | (2) | (2) | 1,025 | $9,382 | 660 | $5,070 |
| School slates----------cases [3]-- | 2,651 | $20,204 | 4,434 | 35,011 | 4,642 | 35,717 |
| Electrical slate----------square feet-- | 5,528 | 4,449 | 3,986 | 2,356 | 1,885 | 1,239 |
| Blackboards----------do----- | 53,486 | 15,502 | 26,033 | 6,853 | 46,253 | 10,400 |
| Billiard tables----------do----- | 26,729 | 10,601 | 30,443 | 16,580 | 17,788 | 10,182 |
| Structural [4]----------do----- | 25,592 | 5,831 | 26,462 | 4,393 | 18,188 | 1,314 |
| Slate granules and flour-------short tons-- | 9,412 | 67,012 | 11,184 | 77,576 | 11,229 | 93,675 |
| | ---------- | [5] 123,599 | ---------- | 152,151 | ---------- | 157,597 |

[1] Figures collected by Bureau of Mines from shippers of products named.
[2] Figures not available.
[3] Cases weigh 130 to 165 pounds each; average is 135 pounds. They contain 8 to 18 dozen slates, depending on size. Sizes run from 5 by 7 to 9 by 13 inches (inside frame).
[4] Includes slate for floors and walkways.
[5] Excludes roofing.

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# SAND AND GRAVEL

By H. Herbert Hughes and G. Egge

## SUMMARY OUTLINE


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Outstanding in the sand and gravel industry in 1938 was the further shift to noncommercial operations for supplies of aggregates. The output of plants operated by States, counties, municipalities, and other Government agencies, as reported to the Bureau of Mines, was 17 percent higher than in 1937 and comprised 42 percent of the total tonnage. Commercial production dropped 16 percent. The

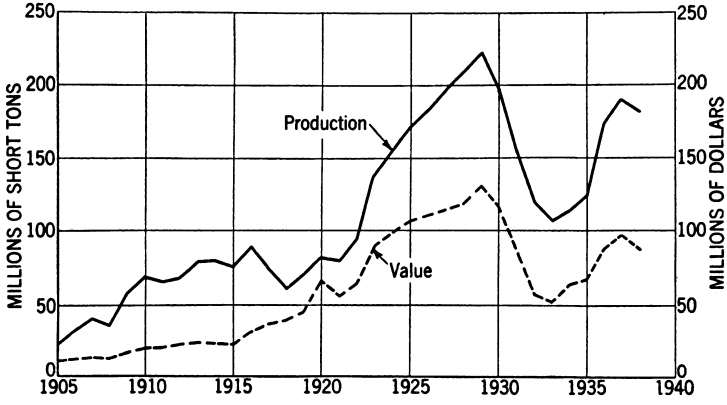


Figure 1.—Principal trends in the sand and gravel industry, 1905-38.

total quantity of sand and gravel sold or used for all purposes decreased 4 percent from 1937, and this decline correlates closely with statistics of construction and other indicators of outlets for sand and gravel. The drop in 1938 interrupted the continuous rise from the low in 1933. (See fig. 1.)

The total value of construction contracts awarded in 1938 was 10 percent higher than in 1937, but this rise was due entirely to sharp gains late in the year which, for the most part, did not result



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in demand for materials until early in 1939. A similar situation existed in contracts awarded for engineering construction and concrete paving, which advanced 15 and 11 percent, respectively. Construction financed by public funds increased 48 percent and contracts for public works 45 percent in 1938 compared with 1937. Despite a drop of 15 percent in privately financed construction, residential contract awards were 9 percent above 1937. Residential construction was particularly active in the last quarter of 1938.

In general, prices of sand and gravel in 1938 were slightly below those in 1937, although producers reported an increase in the average value per ton for some industrial sands. In 1938, as in earlier years, the average value of the noncommercial output was low—a reflection of the high percentage of unprepared material included in this category.

Salient statistics of the sand and gravel industry in 1937 and 1938 are summarized in the following table.

*Sand and gravel sold or used by producers in the United States, 1937–38, by commercial and noncommercial operations and by uses*

| | 1937 | | | 1938 | | | | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | | Percent of change in— | |
| | | Total | Average | | Total | Average | Tonnage | Average value |
| COMMERCIAL OPERATIONS | | | | | | | | |
| Sand: | | | | | | | | |
| Glass | 2,799,230 | $4,746,629 | $1.70 | 2,109,462 | $3,601,734 | $1.71 | −24.6 | +0.6 |
| Molding | 4,953,873 | 5,239,435 | 1.06 | 2,319,902 | 2,651,779 | 1.14 | −53.2 | +7.5 |
| Building | 26,050,459 | 14,809,078 | .57 | 22,939,683 | 12,888,823 | .56 | −11.9 | −1.8 |
| Paving | 17,395,013 | 9,487,817 | .55 | 16,755,634 | 9,388,865 | .56 | −3.7 | +1.8 |
| Grinding and polishing | 1,067,178 | 1,440,736 | 1.35 | [1] 502,328 | [1] 754,805 | 1.50 | −52.9 | +11.1 |
| Fire or furnace | 258,287 | 268,355 | 1.04 | 108,093 | 124,343 | 1.15 | −58.2 | +10.6 |
| Engine | 1,802,869 | 1,092,171 | .61 | 1,378,450 | 786,639 | .57 | −23.5 | −6.6 |
| Filter | 99,383 | 182,414 | 1.84 | 93,711 | 137,283 | 1.46 | −5.7 | −20.7 |
| Railroad ballast [3] | 1,418,316 | 334,585 | .24 | 786,435 | 212,935 | .27 | −44.6 | +12.5 |
| Other | 1,295,419 | 1,058,162 | .82 | 1,339,556 | 1,124,739 | .84 | +3.4 | +2.4 |
| Total commercial sand | 57,140,027 | 38,659,382 | .68 | 48,333,254 | 31,671,945 | .66 | −15.4 | −2.9 |
| Gravel: | | | | | | | | |
| Building | 24,876,957 | 18,130,011 | .73 | 19,014,937 | 13,283,044 | .70 | −23.6 | −4.1 |
| Paving | 30,156,314 | 17,991,964 | .60 | 29,180,197 | 17,391,259 | .60 | −3.2 | |
| Railroad ballast [3] | 12,318,575 | 3,757,068 | .30 | 8,194,244 | 2,255,355 | .28 | −33.5 | −6.7 |
| Other | 850,605 | 575,893 | .68 | 1,037,154 | 414,275 | .40 | +21.9 | −41.2 |
| Total commercial gravel | 68,202,451 | 40,454,936 | .59 | 57,426,532 | 33,343,933 | .58 | −15.8 | −1.7 |
| Total commercial sand and gravel | 125,342,478 | 79,114,318 | .63 | 105,759,786 | 65,015,878 | .61 | −15.6 | −3.2 |
| NONCOMMERCIAL OPERATIONS [4] | | | | | | | | |
| Sand: | | | | | | | | |
| Building | 1,540,280 | 595,953 | .39 | 2,157,501 | 890,224 | .41 | +40.1 | +5.1 |
| Paving | 4,704,764 | 1,157,162 | .25 | 6,623,073 | 1,373,556 | .21 | +40.8 | −16.0 |
| Total noncommercial sand | 6,245,044 | 1,753,115 | .28 | 8,780,574 | 2,263,780 | .26 | +40.6 | −7.1 |

See footnotes at end of table.

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*Sand and gravel sold or used by producers in the United States, 1937–38, by commercial and noncommercial operations and by uses*—Continued

| | 1937 | | | 1938 | | | | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | | Percent of change in— | |
| | | Total | Average | | Total | Average | Tonnage | Average value |
| NONCOMMERCIAL OPERATIONS—continued. | | | | | | | | |
| Gravel: | | | | | | | | |
| Building | 2,961,360 | $1,396,202 | $0.47 | 7,299,822 | $2,454,783 | $0.34 | +146.5 | −27.7 |
| Paving | 55,111,541 | 15,209,362 | .28 | 59,480,051 | 16,188,406 | .27 | +7.9 | −3.6 |
| Total noncommercial gravel | 58,072,901 | 16,605,564 | .29 | 66,779,873 | 18,643,189 | .28 | +15.0 | −3.4 |
| Total noncommercial sand and gravel | 64,317,945 | 18,358,679 | .29 | 75,560,447 | 20,906,969 | .28 | +17.5 | −3.4 |
| COMMERCIAL AND NONCOMMERCIAL OPERATIONS | | | | | | | | |
| Sand | 63,385,071 | 40,412,497 | .64 | 57,113,828 | 33,935,725 | .59 | −9.9 | −7.8 |
| Gravel | 126,275,352 | 57,060,500 | .45 | 124,206,405 | 51,987,122 | .42 | −1.6 | −6.7 |
| Grand total | 189,660,423 | 97,472,997 | .51 | 181,320,233 | 85,922,847 | .47 | −4.4 | −7.8 |

[1] Includes 205,753 tons of blast sand valued at $509,178.

[2] Includes some sand used for fills and similar purposes. The quantity of sand reported as used exclusively for railroad ballast in 1937 was 1,330,204 tons valued at $315,988 and in 1938, 672,829 tons, $195,469. The figures include sand produced by railroads for their own use as follows—1937: Ballast, 201,488 tons, $21,363, and fills and similar purposes, 88,112 tons, $18,597; 1938: Ballast, 128,079 tons, $25,806, and fills and similar purposes, 113,606 tons, $17,466.

[3] Includes some gravel used for fills and similar purposes. The quantity of gravel reported as used exclusively for railroad ballast in 1937 was 11,527,192 tons valued at $3,650,278 and in 1938, 7,271,502 tons, $2,179,462. The figures include gravel produced by railroads for their own use as follows—1937: Ballast, 5,343,956 tons, $843,851, and fills and similar purposes, 791,383 tons, $106,790; 1938: Ballast, 3,590,684 tons, $645,133, and fills and similar purposes, 922,742 tons, $75,893.

[4] By States, counties, municipalities, and other Government agencies directly or under lease.

Sales of sand and gravel by commercial producers for all major uses were lower in 1938 than in 1937. Sales of paving sand and gravel dropped 4 and 3 percent, respectively, whereas output of noncommercial paving sand and gravel increased appreciably. This would seem to indicate increased activity in low-cost road construction, but a drop of 9 percent in road-oil sales and increases of 11 and 9 percent, respectively, in concrete paving and domestic demand for asphalt do not support this inference.

As was indicated by data on construction, total sales of building sand and gravel in 1938 were 9 and 5 percent, respectively, lower than in 1937. Sharp increases of 40 and nearly 150 percent in noncommercial building sand and gravel failed to offset decreases of 12 and 24 percent, respectively, in commercial output. The rise in noncommercial production was related to the WPA program.

Sales of some industrial sands were less than half those in 1937. The output of glass sand was 25 percent lower in 1938, owing to decreases of 18 and 56 percent, respectively, in production of glass containers and polished plate glass. Curtailment of activity in the iron

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and steel and foundry industries resulted in declines of more than 50 percent in output of molding and fire or furnace sands. Grinding and polishing sand also dropped more than 50 percent. Sharp decreases in engine sand and railroad-ballast sand and gravel were due to the continued depressed condition of the railroads. The output of filter sand dropped only 6 percent. The only increase in quantity in 1938 was in material unclassified as to use.

## PRODUCTION

Except for small supplies to meet seasonal peaks, stocks are of little consequence in the sand and gravel industry, and the quantity of materials sold or used by producers is virtually equivalent to production. Throughout this report sales and production are used interchangeably.

The relative importance of gravel continued to increase in 1938. It comprised 69 percent of the total tonnage compared with 67 percent in 1937 and only 53 percent in 1928. This increase shows that the use of gravel is expanding, although a large part of the rise represents noncommercial production used in low-type roads.

Complete production data for 1938 are included in this report. Statistics of sand and gravel sold or used by commercial and noncommercial producers from 1934 to 1938 are summarized in the following table.

*Sand and gravel sold or used by commercial and noncommercial producers in the United States, 1934–38*

| Year | Sand | | Gravel (including railroad ballast) | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 38,400,090 | $24,881,071 | 78,211,599 | $36,366,102 | 116,611,689 | $61,247,173 |
| 1935 | 40,433,559 | 25,867,222 | 83,490,364 | 36,110,157 | 123,923,923 | 61,977,379 |
| 1936 | 60,303,394 | 35,926,994 | 118,026,420 | 54,380,758 | 178,329,814 | 90,307,752 |
| 1937 | 63,385,071 | 40,412,497 | 126,275,352 | 57,060,500 | 189,660,423 | 97,472,997 |
| 1938 | 57,113,828 | 33,935,725 | 124,206,405 | 51,987,122 | 181,320,233 | 85,922,847 |

New York, Illinois, and California led all States in output of sand and gravel in 1938, although Pennsylvania ranked third on the basis of value because of its large production of glass and other high-priced industrial sands. Details of production in 1938 by States and uses are given in the following tables. This year, for the first time, the table by States is designed to show the break-down by commercial and noncommercial producers.

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*Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses*

| State | Sand | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Glass | | Molding | | Building | | | |
| | | | | | Commercial | | Noncommercial | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | | | (1) | (1) | 226,399 | $89,493 | 42,500 | $1,840 |
| Alaska | | | | | (1) | (1) | (1) | (1) |
| Arizona | | | | | 94,360 | 55,854 | 203,215 | 87,595 |
| Arkansas | (1) | (1) | (1) | (1) | 139,755 | 74,517 | 25,845 | 31,981 |
| California | (1) | (1) | 30,445 | $71,813 | 3,227,145 | 2,034,512 | 174,515 | 69,417 |
| Colorado | | | | | 121,529 | 71,969 | 90,558 | 32,686 |
| Connecticut | | | (1) | (1) | 271,880 | 164,392 | (1) | (1) |
| Delaware | | | (1) | (1) | 56,940 | 34,388 | | |
| Florida | | | | | 457,434 | 234,534 | 10,234 | 1,375 |
| Georgia | 16,688 | $13,110 | (1) | (1) | 98,893 | 35,166 | (1) | (1) |
| Hawaii | | | | | | | (1) | (1) |
| Idaho | | | | | 9,561 | 6,334 | 43,127 | 36,946 |
| Illinois | (1) | (1) | 359,363 | 356,799 | 1,023,497 | 506,307 | 121,821 | 36,687 |
| Indiana | | | 124,297 | 81,921 | 951,064 | 405,181 | 110,971 | 73,490 |
| Iowa | | | (1) | (1) | 398,025 | 234,268 | 17,588 | 2,289 |
| Kansas | | | | | 457,206 | 199,270 | 64,711 | 23,567 |
| Kentucky | | | 3,331 | 7,722 | 299,231 | 285,756 | (1) | (1) |
| Louisiana | | | | | 415,756 | 164,661 | | |
| Maine | | | | | 11,189 | 4,717 | 2,800 | 200 |
| Maryland | (1) | (1) | | | 410,137 | 344,768 | (1) | (1) |
| Massachusetts | | | (1) | (1) | 783,835 | 378,386 | 16,279 | 6,072 |
| Michigan | (1) | (1) | 471,680 | 160,888 | 886,107 | 274,609 | 13,449 | 8,007 |
| Minnesota | | | 12,546 | 13,125 | 622,334 | 233,870 | 174,810 | 31,362 |
| Mississippi | | | | | 48,724 | 15,773 | (1) | (1) |
| Missouri | 167,605 | 255,243 | 21,088 | 17,013 | 443,824 | 223,170 | (1) | (1) |
| Montana | | | | | 31,947 | 25,848 | (1) | (1) |
| Nebraska | | | | | 205,181 | 62,922 | | |
| Nevada | (1) | (1) | 6,127 | 10,497 | 22,317 | 18,278 | 3,695 | 1,752 |
| New Hampshire | | | | | 9,481 | 4,077 | 5,404 | 386 |
| New Jersey | 273,363 | 419,104 | 383,842 | 551,304 | 884,882 | 415,818 | 10,812 | 638 |
| New Mexico | | | | | (1) | (1) | 13,783 | 4,999 |
| New York | | | 249,792 | 403,418 | 4,081,616 | 1,923,623 | 116,342 | 16,408 |
| North Carolina | | | | | 60,165 | 28,218 | 19,065 | 8,862 |
| North Dakota | | | | | 20,914 | 4,403 | 30,275 | 1,528 |
| Ohio | (1) | (1) | 297,791 | 507,916 | 1,283,601 | 851,595 | 10,712 | 5,488 |
| Oklahoma | (1) | (1) | | | 183,242 | 77,597 | (1) | (1) |
| Oregon | | | | | 169,315 | 116,380 | (1) | (1) |
| Pennsylvania | (1) | (1) | 164,314 | 254,017 | 1,160,031 | 1,112,035 | (1) | (1) |
| Rhode Island | | | (1) | (1) | 26,832 | 9,442 | 3,710 | 1,265 |
| South Carolina | (1) | (1) | | | 88,170 | 48,664 | 4,795 | 2,619 |
| South Dakota | | | | | 54,320 | 29,238 | 7,846 | 3,439 |
| Tennessee | | | (1) | (1) | 377,077 | 328,851 | 90,134 | 92,130 |
| Texas | (1) | (1) | 3,852 | 6,591 | 572,437 | 402,379 | 410,186 | 172,819 |
| Utah | | | (1) | (1) | 106,989 | 49,229 | 22,299 | 4,006 |
| Vermont | | | | | | | 19,270 | 17,343 |
| Virginia | (1) | (1) | 6,415 | 4,029 | 410,985 | 329,932 | 40,822 | 6,454 |
| Washington | | | (1) | (1) | 897,458 | 508,433 | 19,020 | 10,053 |
| West Virginia | (1) | (1) | (1) | (1) | 211,266 | 204,379 | (1) | (1) |
| Wisconsin | | | 48,181 | 22,306 | 593,490 | 230,500 | 145,540 | 36,075 |
| Wyoming | | | | | 8,958 | 13,435 | 43,335 | 44,081 |
| Undistributed [2] | 1,651,806 | 2,914,277 | 136,838 | 182,420 | 24,184 | 21,652 | 28,033 | 16,365 |
| | 2,109,462 | 3,601,734 | 2,319,902 | 2,651,779 | 22,939,683 | 12,888,823 | 2,157,501 | 890,224 |

See footnotes at end of table.

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*Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses*—Continued

| State | Sand—Continued | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Paving | | | | Grinding and polishing [2] | | Fire or furnace | |
| | Commercial | | Noncommercial | | | | | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 129,532 | $91,960 | 2,048,145 | $163,002 | | | | |
| Alaska | | | | | | | | |
| Arizona | (1) | (1) | 26,335 | 9,652 | | | | |
| Arkansas | 104,872 | 62,119 | (1) | (1) [4] | | | | |
| California | 1,146,664 | 633,554 | 116,154 | 55,046 | 11,763 | $31,513 | (1) | (1) |
| Colorado | 44,216 | 25,410 | 139,378 | 12,948 | (1) | (1) | | |
| Connecticut | 121,613 | 66,662 | 476,468 | 37,701 | (1) | (1) | | |
| Delaware | 7,367 | 3,948 | | | (1) | (1) | | |
| Florida | 132,921 | 82,365 | 7,000 | 1,000 | | | | |
| Georgia | 206,663 | 103,087 | (1) | (1) | 8,438 | 9,303 | | |
| Hawaii | | | | | | | | |
| Idaho | (1) | (1) | 74,857 | 18,735 | | | | |
| Illinois | 1,034,799 | 489,329 | 52,440 | 18,226 | 61,175 | 184,258 | 10,432 | $16,864 |
| Indiana | 690,022 | 345,580 | (1) | (1) | | | 26,350 | 9,250 |
| Iowa | 622,169 | 279,129 | (1) | (1) | 10,095 | 9,759 | | |
| Kansas | 651,602 | 256,251 | 114,400 | 35,638 | 16,613 | 6,730 | | |
| Kentucky | 213,494 | 129,478 | | | | | | |
| Louisiana | 243,437 | 131,935 | | | (1) | (1) | | |
| Maine | 25,202 | 9,322 | 15,581 | 7,984 | (1) | (1) | | |
| Maryland | 624,834 | 491,686 | (1) | (1) | (1) | (1) | (1) | (1) |
| Massachusetts | 447,102 | 192,181 | 35,677 | 3,567 | (1) | (1) | (1) | (1) |
| Michigan | 1,180,803 | 444,206 | 139,508 | 21,387 | 46,389 | 30,947 | | |
| Minnesota | 143,210 | 56,330 | (1) | (1) | (1) | (1) | | |
| Mississippi | 521,025 | 207,818 | 205,443 | 51,406 | | | | |
| Missouri | 419,507 | 232,759 | 8,836 | 5,647 | 51,361 | 81,572 | (1) | (1) |
| Montana | 8,980 | 8,775 | 8,904 | 3,250 | | | | |
| Nebraska | 83,757 | 25,885 | 64,064 | 18,090 | (1) | (1) | | |
| Nevada | 148 | 109 | 9,897 | 3,454 | 916 | 2,106 | | |
| New Hampshire | 30,688 | 11,940 | 614,914 | 39,174 | | | | |
| New Jersey | 800,835 | 429,954 | | | 47,481 | 98,932 | 13,907 | 22,016 |
| New Mexico | | | 52,920 | 36,859 | | | | |
| New York | 1,996,109 | 973,873 | 33,524 | 9,715 | (1) | (1) | | |
| North Carolina | 140,815 | 78,787 | 1,375,686 | 291,557 | | | | |
| North Dakota | 24,383 | 9,185 | 6,383 | 823 | | | | |
| Ohio | 1,163,257 | 698,066 | 17,880 | 7,810 | (1) | (1) | (1) | (1) |
| Oklahoma | 74,934 | 32,380 | 20,636 | 6,003 | | | | |
| Oregon | 69,193 | 35,594 | 11,200 | 5,200 | | | | |
| Pennsylvania | 1,237,875 | 1,252,905 | (1) | (1) | 120,874 | 121,710 | 12,880 | 23,071 |
| Rhode Island | 22,084 | 11,314 | 30,677 | 22,137 | | | | |
| South Carolina | 47,232 | 24,027 | 101,948 | 25,119 | | | | |
| South Dakota | 72,012 | 36,588 | 28,614 | 6,680 | | | | |
| Tennessee | 305,351 | 207,357 | 30,811 | 27,332 | 19,685 | 27,061 | 713 | 785 |
| Texas | 659,497 | 385,935 | 100,231 | 95,091 | 1,054 | 1,042 | | |
| Utah | 38,049 | 18,085 | 133,706 | 81,069 | | | | |
| Vermont | 17,303 | 13,020 | 9,927 | 4,803 | 39,367 | 1,405 | | |
| Virginia | 537,420 | 382,248 | 160,665 | 56,108 | | | | |
| Washington | 124,002 | 63,474 | 169,652 | 63,481 | | | | |
| West Virginia | 155,607 | 132,964 | 9,303 | 12,718 | (1) | (1) | | |
| Wisconsin | 406,488 | 198,659 | 146,802 | 100,072 | 36,477 | 59,376 | 4,270 | 3,843 |
| Wyoming | 2,223 | 2,078 | 10,257 | 10,346 | | | | |
| Undistributed [3] | 26,338 | 20,554 | 14,250 | 4,726 | 30,640 | 89,091 | 39,541 | 48,514 |
| | 16,755,634 | 9,388,865 | 6,623,073 | 1,373,556 | 502,328 | 754,805 | 108,093 | 124,343 |

See footnotes at end of table.

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*Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses*—Continued

| State | Sand—Continued | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Engine | | Filter | | Railroad ballast [4] | | Other | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | (1) | (1) | | | | | | |
| Alaska | | | | | | | | |
| Arizona | 4,454 | $2,316 | | | 1,111 | $889 | 4,200 | $1,680 |
| Arkansas | (1) | (1) | | | | | | |
| California | 28,516 | 10,442 | (1) | (1) | (1) | (1) | 9,877 | 8,571 |
| Colorado | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Connecticut | (1) | (1) | (1) | (1) | 100 | 50 | 13,274 | 7,473 |
| Delaware | (1) | (1) | (1) | (1) | | | (1) | (1) |
| Florida | (1) | (1) | (1) | (1) | 18,306 | 3,639 | 9,909 | 6,556 |
| Georgia | 20,464 | 5,751 | 909 | $2,727 | | | 13,390 | 8,695 |
| Hawaii | | | | | | | | |
| Idaho | (1) | (1) | | | | | 780 | 323 |
| Illinois | 38,235 | 22,501 | (1) | (1) | 191,565 | 51,032 | 172,114 | 181,675 |
| Indiana | 95,702 | 31,089 | | | (1) | (1) | (1) | (1) |
| Iowa | 37,885 | 20,282 | (1) | (1) | 18,594 | 11,308 | 10,410 | 2,642 |
| Kansas | 32,533 | 14,998 | (1) | (1) | | | 45,772 | 18,283 |
| Kentucky | (1) | (1) | | | 7,424 | 3,341 | (1) | (1) |
| Louisiana | 10,107 | 3,485 | (1) | (1) | 20,785 | 4,638 | (1) | (1) |
| Maine | 2,998 | 904 | (1) | (1) | 8,121 | 2,099 | | |
| Maryland | (1) | (1) | | | | | | |
| Massachusetts | 25,925 | 7,488 | 4,150 | 1,920 | 487 | 73 | 27,896 | 12,922 |
| Michigan | 11,433 | 3,779 | | | (1) | (1) | 71,337 | 18,858 |
| Minnesota | 34,771 | 7,858 | 516 | 1,548 | 48,848 | 10,825 | (1) | (1) |
| Mississippi | 17,053 | 4,710 | | | (1) | (1) | (1) | (1) |
| Missouri | 23,364 | 12,435 | (1) | (1) | 14,793 | 8,147 | (1) | (1) |
| Montana | 3,517 | 351 | | | 11,616 | 1,437 | | |
| Nebraska | 46,700 | 15,439 | (1) | (1) | | | 12,445 | 2,741 |
| Nevada | 480 | 560 | (1) | (1) | 5,800 | 462 | (1) | (1) |
| New Hampshire | | | | | | | (1) | (1) |
| New Jersey | (1) | (1) | 39,510 | 52,540 | | | (1) | (1) |
| New Mexico | (1) | (1) | | | (1) | (1) | | |
| New York | 60,893 | 27,926 | 5,913 | 2,680 | (1) | (1) | 296,126 | 90,140 |
| North Carolina | (1) | (1) | (1) | (1) | 12,097 | 7,362 | 33,840 | 14,423 |
| North Dakota | | | | | | | | |
| Ohio | 45,494 | 33,826 | 12,034 | 12,753 | 54,419 | 13,623 | 114,471 | 336,702 |
| Oklahoma | 20,927 | 9,662 | (1) | (1) | 8,353 | 1,819 | 1,966 | 841 |
| Oregon | 16,222 | 3,860 | | | (1) | (1) | (1) | (1) |
| Pennsylvania | 178,354 | 185,076 | (1) | (1) | (1) | (1) | 137,496 | 164,129 |
| Rhode Island | | | | | | | (1) | (1) |
| South Carolina | 1,645 | 352 | | | 21,588 | 2,608 | | |
| South Dakota | (1) | (1) | | | (1) | (1) | | |
| Tennessee | 32,795 | 30,436 | | | (1) | (1) | (1) | (1) |
| Texas | 28,024 | 10,284 | (1) | (1) | 142,821 | 26,782 | (1) | (1) |
| Utah | (1) | (1) | | | | | (1) | (1) |
| Vermont | 800 | 555 | | | | | | |
| Virginia | (1) | (1) | | | | | (1) | (1) |
| Washington | 23,662 | 5,376 | | | (1) | (1) | (1) | (1) |
| West Virginia | 207,893 | 157,798 | (1) | (1) | (1) | (1) | 20,347 | 48,045 |
| Wisconsin | 44,810 | 9,334 | 6,594 | 5,865 | 25,615 | 4,168 | 8,461 | 3,473 |
| Wyoming | | | | | | | | |
| Undistributed [5] | 282,804 | 147,766 | 24,085 | 57,250 | 173,992 | 58,633 | 335,445 | 196,567 |
| | 1,378,450 | 786,639 | 93,711 | 137,283 | 786,435 | 212,935 | 1,339,556 | 1,124,739 |

See footnotes at end of table.

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*Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses*—Continued

| State | Gravel | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Building | | | | Paving | | | |
| | Commercial | | Noncommercial | | Commercial | | Noncommercial | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 217,865 | $121,619 | 12,220 | $12,100 | 316,825 | $235,694 | 44,300 | $18,021 |
| Alaska | (1) | (1) | 4,309 | 1,847 | (1) | (1) | 128,762 | 35,453 |
| Arizona | 192,901 | 104,219 | 530,309 | 214,515 | (1) | (1) | 57,910 | 38,629 |
| Arkansas | 28,839 | 18,764 | 32,200 | 3,300 | 216,769 | 150,950 | 817,680 | 250,578 |
| California | 3,064,989 | 2,258,186 | 594,580 | 372,593 | 1,829,134 | 1,173,909 | 1,182,582 | 501,006 |
| Colorado | 113,005 | 83,111 | 338,957 | 71,208 | 398,841 | 185,260 | 2,530,415 | 919,810 |
| Connecticut | 144,005 | 110,589 | | | 70,514 | 36,588 | 209,594 | 79,427 |
| Delaware | 3,250 | 3,737 | | | 777 | 699 | | |
| Florida | (1) | (1) | | | (1) | (1) | | |
| Georgia | | | (1) | (1) | (1) | (1) | 17,134 | 12,514 |
| Hawaii | | | | | | | (1) | (1) |
| Idaho | 58,158 | 15,579 | 444,976 | 169,490 | 134,007 | 51,165 | 1,114,026 | 410,762 |
| Illinois | 1,081,856 | 565,303 | 77,778 | 29,946 | 2,781,580 | 1,169,935 | 3,936,774 | 1,134,734 |
| Indiana | 658,490 | 452,887 | 87,140 | 54,306 | 1,889,844 | 1,214,533 | 330,304 | 70,493 |
| Iowa | 355,624 | 291,231 | 456,841 | 65,195 | 1,308,040 | 586,234 | 3,510,819 | 689,251 |
| Kansas | 89,943 | 38,977 | 335,160 | 127,020 | 537,011 | 247,753 | 610,425 | 143,174 |
| Kentucky | 326,012 | 308,612 | (1) | (1) | 267,571 | 184,838 | | |
| Louisiana | 567,481 | 356,798 | | | 654,202 | 437,801 | 60,343 | 4,310 |
| Maine | 25,393 | 16,754 | 5,158 | 552 | 118,034 | 38,453 | 3,393,632 | 836,779 |
| Maryland | 308,211 | 291,830 | (1) | (1) | 579,650 | 664,780 | 226,835 | 16,202 |
| Massachusetts | 412,259 | 298,686 | 305,596 | 30,481 | 370,892 | 186,884 | 505,314 | 46,774 |
| Michigan | 757,742 | 424,242 | 412,880 | 141,784 | 2,287,953 | 966,316 | 3,186,938 | 945,493 |
| Minnesota | 474,637 | 398,270 | 213,108 | 73,231 | 560,342 | 253,799 | 5,251,134 | 337,777 |
| Mississippi | 92,411 | 39,936 | 49,357 | 2,115 | 1,222,245 | 668,305 | 993,497 | 230,123 |
| Missouri | 373,044 | 220,669 | (1) | (1) | 841,379 | 403,409 | 773,562 | 361,423 |
| Montana | 441,964 | 169,091 | 82,692 | 27,404 | 289,800 | 212,225 | 1,624,961 | 524,231 |
| Nebraska | 365,625 | 127,790 | 20,200 | 5,250 | 1,042,496 | 381,278 | 1,085,602 | 377,638 |
| Nevada | | | 26,869 | 3,706 | 292,191 | 109,104 | 1,244,327 | 362,446 |
| New Hampshire | 12,549 | 12,306 | | | 68,993 | 55,494 | 1,422,691 | 111,598 |
| New Jersey | 266,594 | 211,660 | 77,771 | 6,528 | 343,513 | 262,724 | (1) | (1) |
| New Mexico | (1) | (1) | 46,374 | 63,141 | | | 1,856,160 | 1,066,205 |
| New York | 2,312,829 | 1,631,062 | 243,160 | 28,334 | 1,751,586 | 1,071,788 | 2,377,077 | 301,622 |
| North Carolina | (1) | (1) | (1) | (1) | 60,536 | 49,569 | 676,944 | 179,341 |
| North Dakota | 8,754 | 8,992 | 412,714 | 16,205 | 100,339 | 22,833 | 1,903,087 | 81,128 |
| Ohio | 965,946 | 676,469 | 48,899 | 7,635 | 2,538,326 | 1,668,214 | 723,095 | 145,098 |
| Oklahoma | 20,800 | 12,523 | 296,670 | 73,388 | 113,719 | 79,967 | 57,197 | 24,950 |
| Oregon | 227,155 | 143,099 | 150,921 | 98,115 | 357,416 | 168,674 | 884,917 | 293,435 |
| Pennsylvania | 810,077 | 757,590 | | | 1,156,588 | 1,085,905 | 299,964 | 54,312 |
| Rhode Island | 15,392 | 9,056 | (1) | (1) | 48,038 | 30,047 | 109,616 | 81,207 |
| South Carolina | 91,738 | 99,329 | | | 65,770 | 70,762 | | |
| South Dakota | 13,245 | 9,105 | 217,563 | 9,921 | 43,540 | 13,625 | 4,135,504 | 506,033 |
| Tennessee | 291,141 | 218,468 | 47,881 | 39,934 | 572,115 | 361,611 | 563,561 | 171,503 |
| Texas | 760,427 | 668,584 | 921,150 | 390,350 | 1,178,949 | 951,790 | 1,980,452 | 514,277 |
| Utah | 122,075 | 57,987 | 105,301 | 14,783 | 224,827 | 74,030 | 1,948,845 | 949,523 |
| Vermont | | | | | 3,100 | 221 | 913,768 | 458,285 |
| Virginia | 330,854 | 339,948 | 18,297 | 18,874 | 687,954 | 705,164 | 418,416 | 213,471 |
| Washington | 1,557,618 | 917,346 | 64,277 | 19,755 | 508,417 | 328,484 | 2,423,178 | 909,722 |
| West Virginia | 177,004 | 157,089 | | | 333,636 | 265,667 | 66,734 | 39,348 |
| Wisconsin | 421,164 | 203,004 | 526,458 | 169,933 | 862,268 | 439,626 | 2,472,214 | 1,188,093 |
| Wyoming | 12,130 | 17,856 | 83,728 | 83,690 | 69,195 | 35,616 | 1,403,916 | 550,989 |
| Undistributed [2] | 443,741 | 414,691 | 8,328 | 8,154 | 81,275 | 89,536 | 5,845 | 1,218 |
| | 19,014,937 | 13,283,044 | 7,299,822 | 2,454,783 | 29,180,197 | 17,391,259 | 59,480,051 | 16,188,406 |

See footnotes at end of table.

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*Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses*—Continued

| State | Gravel—Continued | | | | Sand and gravel | | | |
|---|---|---|---|---|---|---|---|---|
| | Railroad ballast [4] | | Other [6] | | Total commercial | | Total noncommercial | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | | | 8,903 | $3,237 | 963,018 | $587,168 | 2,147,165 | $194,963 |
| Alaska | | | | | (1) | (1) | 133,232 | 37,380 |
| Arizona | (1) | (1) | | | 367,196 | 198,903 | 817,769 | 350,391 |
| Arkansas | 247,623 | $92,097 | (1) | (1) | 820,789 | 492,623 | 876,811 | 286,596 |
| California | 350,113 | 59,228 | 7,994 | 12,053 | 9,827,441 | 6,579,525 | 2,067,831 | 998,062 |
| Colorado | | | (1) | (1) | 742,451 | 396,323 | 3,099,308 | 1,036,652 |
| Connecticut | (1) | (1) | (1) | (1) | 689,501 | 405,349 | 687,462 | 117,428 |
| Delaware | | | | | 108,875 | 63,366 | | |
| Florida | | | (1) | (1) | 979,447 | 669,731 | 17,234 | 2,375 |
| Georgia | | | (1) | (1) | 373,210 | 191,572 | 22,548 | 15,476 |
| Hawaii | | | | | | | (1) | (1) |
| Idaho | 81,743 | 5,856 | (1) | (1) | 291,082 | 85,424 | 1,676,986 | 635,933 |
| Illinois | 1,166,371 | 392,166 | 53,692 | 26,676 | 8,349,656 | 4,429,008 | 4,188,813 | 1,219,593 |
| Indiana | 414,400 | 180,567 | 61,369 | 28,016 | 4,948,011 | 2,758,187 | 531,537 | 200,286 |
| Iowa | 152,600 | 31,062 | 59,090 | 37,722 | 3,007,598 | 1,542,447 | 3,986,648 | 757,235 |
| Kansas | (1) | (1) | (1) | (1) | 1,838,135 | 787,654 | 1,124,696 | 329,399 |
| Kentucky | (1) | (1) | | | 1,212,233 | 957,800 | (1) | (1) |
| Louisiana | 273,617 | 133,642 | (1) | (1) | 2,188,314 | 1,237,145 | 60,343 | 4,310 |
| Maine | 192,840 | 50,082 | (1) | (1) | 385,533 | 123,251 | 3,417,171 | 845,515 |
| Maryland | | | (1) | (1) | 1,945,481 | 1,831,548 | 231,681 | 16,663 |
| Massachusetts | 158,091 | 20,233 | (1) | (1) | 2,601,179 | 1,141,491 | 862,866 | 86,894 |
| Michigan | 203,687 | 75,234 | 23,132 | 7,290 | 6,068,523 | 2,617,341 | 3,752,775 | 1,116,671 |
| Minnesota | 814,492 | 104,106 | (1) | (1) | 2,844,677 | 1,144,020 | 5,641,470 | 442,816 |
| Mississippi | (1) | (1) | | | 1,988,050 | 963,181 | 1,248,625 | 283,793 |
| Missouri | 82,975 | 50,684 | (1) | (1) | 2,484,198 | 1,550,014 | 785,658 | 369,132 |
| Montana | 436,321 | 88,353 | 3,577 | 2,026 | 1,227,722 | 508,106 | 1,718,850 | 556,168 |
| Nebraska | | | (1) | (1) | 1,759,038 | 619,828 | 1,169,866 | 400,978 |
| Nevada | 364,698 | 128,015 | | | 710,774 | 312,896 | 1,284,788 | 371,358 |
| New Hampshire | (1) | (1) | (1) | (1) | 452,198 | 91,882 | 2,043,009 | 151,158 |
| New Jersey | (1) | (1) | 19,495 | 22,095 | 3,121,223 | 2,511,409 | 94,183 | 8,166 |
| New Mexico | | | | | (1) | (1) | 1,969,237 | 1,171,204 |
| New York | (1) | (1) | 16,353 | 8,707 | 10,796,267 | 6,137,020 | 2,770,103 | 356,079 |
| North Carolina | 10,512 | 6,301 | | | 431,795 | 279,942 | 2,073,385 | 482,885 |
| North Dakota | 73,466 | 5,477 | 1,450 | 1,250 | 229,306 | 52,140 | 2,352,459 | 99,684 |
| Ohio | 432,106 | 205,354 | 48,009 | 47,714 | 7,141,920 | 5,469,186 | 800,586 | 166,031 |
| Oklahoma | | | (1) | (1) | 446,955 | 248,519 | 376,859 | 105,967 |
| Oregon | 163,387 | 51,161 | (1) | (1) | 1,028,491 | 528,837 | 1,050,535 | 397,824 |
| Pennsylvania | (1) | (1) | 34,162 | 28,482 | 5,418,875 | 5,700,086 | 302,136 | 59,910 |
| Rhode Island | | | (1) | (1) | 140,409 | 88,467 | 144,927 | 104,705 |
| South Carolina | (1) | (1) | (1) | (1) | 357,569 | 277,561 | 106,743 | 27,738 |
| South Dakota | 96,178 | 10,623 | | | 288,066 | 101,271 | 4,389,527 | 526,073 |
| Tennessee | (1) | (1) | 11,257 | 9,930 | 1,710,563 | 1,274,150 | 732,387 | 330,899 |
| Texas | 805,459 | 247,434 | (1) | (1) | 4,235,962 | 2,793,611 | 3,412,019 | 1,172,537 |
| Utah | 51,886 | 8,563 | | | 564,854 | 214,341 | 2,210,151 | 1,049,381 |
| Vermont | 99,860 | 35,054 | | | 160,430 | 50,255 | 942,965 | 480,431 |
| Virginia | 23,023 | 14,090 | 9,592 | 2,217 | 2,158,369 | 1,891,204 | 638,200 | 294,907 |
| Washington | 177,921 | 18,576 | 15,119 | 5,687 | 3,339,685 | 1,858,298 | 2,676,127 | 1,003,011 |
| West Virginia | (1) | (1) | (1) | (1) | 1,578,151 | 1,751,221 | 76,395 | 52,253 |
| Wisconsin | 394,545 | 86,777 | 130,047 | 38,822 | 2,982,410 | 1,305,753 | 3,291,014 | 1,494,173 |
| Wyoming | 259,870 | 23,192 | | | 352,376 | 92,177 | 1,541,236 | 689,106 |
| Undistributed [5] | 666,460 | 131,428 | 533,913 | 132,351 | 101,780 | 104,647 | 14,131 | 6,780 |
| | 8,194,244 | 2,255,355 | 1,037,154 | 414,275 | 105,759,786 | 65,015,878 | 75,560,447 | 20,906,969 |

[1] Included under "Undistributed."
[2] Includes items entered as "1."
[3] Includes 205,753 tons of blast sand valued at $509,178.
[4] Includes some sand used for fills and similar purposes. The quantity of sand reported as used exclusively for railroad ballast was 672,829 tons valued at $195,469. The figures include sand produced by railroads for their own use as follows: Ballast, 128,079 tons, $25,806, and fills and similar purposes, 113,606 tons, $17,466.
[5] Includes some gravel used for fills and similar purposes. The quantity of gravel reported as used exclusively for railroad ballast was 7,271,502 tons valued at $2,179,462. The figures include gravel produced by railroads for their own use as follows: Ballast, 3,590,684 tons, $645,133, and fills and similar purposes. 922,742 tons, $75,893.
[6] May include some gravel used by railroads for fills and miscellaneous purposes.

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*Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States*

| State | Short tons | Value | State | Short tons | Value |
|---|---|---|---|---|---|
| Alabama | 3,110,183 | $782,131 | Nebraska | 2,928,904 | $1,020,806 |
| Alaska | [1] 133,232 | [1] 37,380 | Nevada | 1,995,562 | 684,254 |
| Arizona | 1,184,965 | 549,294 | New Hampshire | 2,495,207 | 243,040 |
| Arkansas | 1,697,600 | 779,219 | New Jersey | 3,215,406 | 2,519,575 |
| California | 11,895,272 | 7,577,587 | New Mexico | [1] 1,969,237 | [1] 1,171,204 |
| Colorado | 3,841,759 | 1,432,975 | New York | 13,566,370 | 6,493,099 |
| Connecticut | 1,376,963 | 522,777 | North Carolina | 2,505,180 | 762,827 |
| Delaware | 108,875 | 63,366 | North Dakota | 2,581,765 | 151,824 |
| Florida | 996,681 | 672,106 | Ohio | 7,942,506 | 5,635,217 |
| Georgia | 395,758 | 207,048 | Oklahoma | 823,814 | 354,486 |
| Hawaii | [2] | [2] | Oregon | 2,079,026 | 926,661 |
| Idaho | 1,968,068 | 721,357 | Pennsylvania | 5,721,011 | 5,759,996 |
| Illinois | 12,538,469 | 5,648,601 | Rhode Island | 285,336 | 193,172 |
| Indiana | 5,479,548 | 2,958,473 | South Carolina | 464,312 | 305,299 |
| Iowa | 6,994,246 | 2,299,682 | South Dakota | 4,677,593 | 627,344 |
| Kansas | 2,962,831 | 1,117,053 | Tennessee | 2,442,950 | 1,605,049 |
| Kentucky | 1,222,658 | 962,508 | Texas | 7,647,981 | 3,966,148 |
| Louisiana | 2,248,657 | 1,241,455 | Utah | 2,775,005 | 1,263,722 |
| Maine | 3,802,704 | 968,766 | Vermont | 1,103,395 | 530,686 |
| Maryland | 2,177,162 | 1,848,211 | Virginia | 2,796,569 | 2,186,111 |
| Massachusetts | 3,464,045 | 1,228,385 | Washington | 6,015,812 | [2] 2,861,309 |
| Michigan | 9,821,298 | 3,734,012 | West Virginia | 1,654,546 | 1,803,474 |
| Minnesota | 8,486,147 | 1,586,836 | Wisconsin | 6,273,424 | 2,799,926 |
| Mississippi | 3,236,675 | 1,246,974 | Wyoming | 1,893,612 | 781,283 |
| Missouri | 3,269,856 | 1,919,146 | Undistributed [3] | 105,486 | 106,719 |
| Montana | 2,946,572 | 1,064,274 | | 181,320,233 | 85,922,847 |

[1] Output of commercial producers included under "Undistributed."
[2] Included under "Undistributed."
[3] Includes items covered by "1" and "2."

*Noncommercial operations.*—Recapitulations to show statistics of sand and gravel reported by States, counties, municipalities, and other Government agencies have now been carried back through 1923,

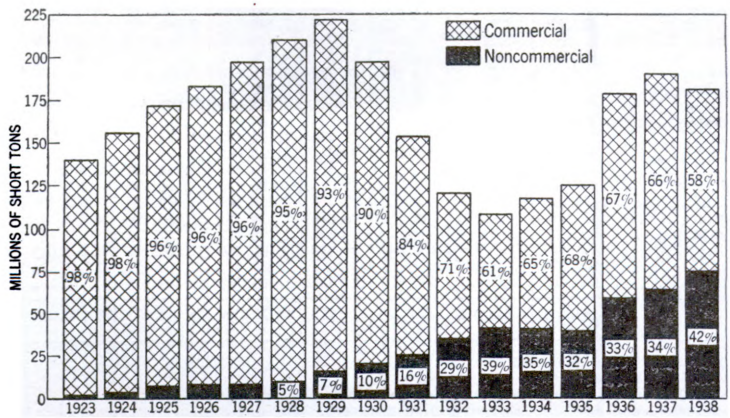


FIGURE 2.—Sand and gravel sold or used in the United States by commercial and noncommercial producers, 1923–38.

although the separate canvass of this material from noncommercial operations was not begun until 1932. Noncommercial production amounted to less than 2 percent of the total output in 1923, but during the depression it rose to more than a third of the total and in 1938 to 42 percent. (See fig. 2.)

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The complete record of noncommercial production since 1923 is summarized in the following table:

*Sand and gravel sold or used by noncommercial producers in the United States, 1923–38, by uses*

| Year | Sand | | | | Gravel | | | | Total noncommercial sand and gravel | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Building | | Paving | | Building | | Paving | | | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1923 | [1] 75,392 | [1] $61,990 | 205,282 | $113,174 | 5,994 | $4,534 | 1,828,808 | $1,165,617 | 2,115,476 | $1,345,315 |
| 1924 | 80,634 | 54,616 | 263,444 | 211,352 | 55,045 | 28,357 | 2,996,704 | 1,927,517 | 3,395,827 | 2,221,842 |
| 1925 | [1] 11,626 | [1] 15,896 | 1,189,860 | 383,781 | 4,200 | 4,527 | 5,805,913 | 3,164,576 | 7,011,599 | 3,568,780 |
| 1926 | 69,741 | 60,250 | 615,568 | 393,617 | 103,753 | 27,793 | 7,070,662 | 3,579,387 | 7,859,724 | 4,061,047 |
| 1927 | 28,436 | 16,435 | 790,465 | 472,683 | 5,304 | 2,981 | 7,322,457 | 4,397,088 | 8,146,662 | 4,889,187 |
| 1928 | 19,705 | 22,913 | 940,135 | 405,440 | 152,347 | 95,381 | 8,487,044 | 5,091,554 | 9,599,231 | 5,615,288 |
| 1929 | 9,889 | 5,914 | 2,253,854 | 819,179 | 42,273 | 19,967 | 14,047,155 | 6,910,775 | 16,353,171 | 7,755,835 |
| 1930 | 4,800 | 3,939 | 1,899,875 | 824,254 | 106,284 | 16,057 | 18,160,661 | 6,963,814 | 20,171,620 | 7,808,064 |
| 1931 | 24,276 | 7,491 | 2,096,907 | 1,156,772 | 49,799 | 37,993 | 22,369,373 | 8,606,311 | 24,540,355 | 9,808,567 |
| 1932 | 147,636 | 97,283 | 2,204,564 | 1,013,337 | 1,000,702 | 253,931 | 31,395,919 | 8,668,487 | 34,748,821 | 10,033,038 |
| 1933 | 163,257 | 84,131 | 1,972,692 | 751,201 | 650,873 | 253,529 | 38,862,055 | 12,589,022 | 41,648,877 | 13,677,883 |
| 1934 | 334,946 | 213,304 | 3,440,830 | 1,069,773 | 655,914 | 441,838 | 36,857,090 | 11,157,491 | 41,288,780 | 12,882,406 |
| 1935 | 543,457 | 272,053 | 2,114,112 | 497,781 | 822,525 | 352,346 | 35,836,358 | 9,611,223 | 39,316,452 | 10,733,403 |
| 1936 | 810,196 | 410,686 | 4,897,922 | 872,904 | 1,251,901 | 896,454 | 51,449,400 | 15,895,317 | 58,409,419 | 18,075,361 |
| 1937 | 1,540,280 | 595,953 | 4,704,764 | 1,157,162 | 2,961,360 | 1,396,202 | 55,111,541 | 15,209,362 | 64,317,945 | 18,358,679 |
| 1938 | 2,157,501 | 890,224 | 6,623,073 | 1,373,556 | 7,299,822 | 2,454,783 | 59,480,051 | 16,188,406 | 75,560,447 | 20,906,969 |

[1] Includes a small quantity of filter sand.

In 1938, as in earlier years, most of the output of noncommercial operations (79 percent) was paving gravel, largely unprepared material for use in low-cost secondary roads. Building-sand and gravel output rose sharply to 13 percent of the total compared with only 7 percent in 1937.

Sand and gravel classed as noncommercial includes that reported by States, counties, municipalities, or other Government agencies, produced either by their own construction or maintenance crews or by contractors expressly for their consumption. Purchases from commercial producers are not included. The quantity produced by contractors was 41 percent of the total in 1938 and 40 percent in 1937. In 1938, as in previous years, more than half the production of noncommercial material was reported by States, about one-third by counties, and the rest by municipalities and other agencies. Details are given in the following table.

*Sand and gravel sold or used by noncommercial producers in the United States, 1935–38, by types of producers*

| Type of producer | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Average value per ton | Short tons | Average value per ton | Short tons | Average value per ton | Short tons | Average value per ton |
| Construction and maintenance crews | 22,011,231 | $0.22 | 31,206,204 | $0.23 | 38,637,673 | $0.21 | 44,745,693 | $0.21 |
| Contractors | 17,305,221 | .34 | 27,203,215 | .40 | 25,680,272 | .40 | 30,814,754 | .37 |
| | 39,316,452 | .27 | 58,409,419 | .31 | 64,317,945 | .29 | 75,560,447 | .28 |
| States | 22,016,880 | .32 | 33,004,590 | .34 | 34,501,864 | .29 | 38,434,738 | .31 |
| Counties | 15,965,458 | .20 | 20,869,867 | .23 | 20,903,014 | .22 | 23,892,718 | .19 |
| Municipalities | 1,027,130 | .32 | 2,126,985 | .27 | 1,616,489 | .29 | 2,232,786 | .33 |
| Other agencies | 306,984 | .73 | 2,407,977 | .56 | 7,296,578 | .42 | 11,000,205 | .34 |
| | 39,316,452 | .27 | 58,409,419 | .31 | 64,317,945 | .29 | 75,560,447 | .28 |

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*Method of transport.*—Shipments of sand and gravel originating on class I railroads in 1938 were 28,384,563 short tons, a drop of 24 percent from the 37,546,068 tons in 1937. This quantity was only 31 percent of the total commercial production reported in 1938, exclusive of glass and molding sand and nonrevenue railroad ballast. The figure indicates a continuing increase in the quantity of sand and gravel moved by other means than rail, as rail shipments were equivalent to 36 percent of commercial production in 1937 and 40 percent in 1936.

Direct reports of methods of transporting sand and gravel were received from producers responsible for 86 percent of the total commercial output. These figures not only show a decided drop in the relative magnitude of rail shipments but also a corresponding increase in shipments by truck and by waterway. Details of shipments, by methods of transport, follow.

*Sand and gravel sold or used by commercial producers in the United States, 1937–38, by methods of transport* [1]

| Method of transport | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Percent of total reported | Short tons | Percent of total reported |
| Shipped by— | | | | |
| Truck | 42,829,073 | 39.3 | 39,142,876 | 43.0 |
| Rail | 51,612,774 | 47.4 | 37,675,155 | 41.3 |
| Waterway | 14,534,833 | 13.3 | 14,278,779 | 15.7 |
| Total reported | 108,976,680 | 100.0 | 91,096,810 | 100.0 |
| Percent of total commercial production | | 86.9 | | 86.1 |

[1] For practical purposes the entire output of noncommercial operations commonly is moved by truck. Including noncommercial production, sand and gravel moved as follows—1937: Truck 61 percent, rail 31 percent, and waterway 8 percent; 1938: Truck 69 percent, rail 23 percent, and waterway 8 percent.

*Preparation.*—The higher average value per ton of sand and gravel reported by commercial producers compared with noncommercial output is a direct result of the cost of washing, screening, or other preparation. In 1938, 88 percent of the commercial production was prepared material, but only 18 percent of the noncommercial output was treated.

*Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1937–38, by commercial and noncommercial operations*

| | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Average value per ton | Percent of total | Short tons | Average value per ton | Percent of total |
| Commercial operations: | | | | | | |
| Prepared | 108,469,032 | $0.68 | 87 | 92,825,363 | $0.66 | 88 |
| Unprepared | 16,873,446 | .31 | 13 | 12,934,423 | .29 | 12 |
| | 125,342,478 | .63 | 100 | 105,759,786 | .61 | 100 |
| Noncommercial operations: | | | | | | |
| Prepared | 12,376,800 | .55 | 19 | 13,833,539 | .49 | 18 |
| Unprepared | 51,941,145 | .22 | 81 | 61,726,908 | .23 | 82 |
| | 64,317,945 | .29 | 100 | 75,560,447 | .28 | 100 |
| Grand total | 189,660,423 | .51 | | 181,320,233 | .47 | |

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*Size of plants.*—Most sand and gravel plants are small. In 1938, 57 percent of all commercial plants reported sales of less than 25,000 tons each and 88 percent of less than 100,000 tons. These two groups produced 10 and 44 percent, respectively, of the total output. There has been a semblance of a trend toward smaller plants in the past few years, as 86 percent of the plants in 1931 reported less than 100,000 tons each and represented only 32 percent of the total tonnage. The following table gives details of production by size groups in 1937 and 1938.

*Comparison of number and output of commercial sand and gravel plants in 1937 and 1938, by size groups* [1]

| Size groups in short tons | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Plants [2] | | Production | | Plants [2] | | Production | |
| | Number | Percent of total | Short tons | Percent of total | Number | Percent of total | Short tons | Percent of total |
| Less than 25,000 | 1,094 | 53.4 | 9,081,000 | 7.6 | 1,195 | 56.6 | 10,300,000 | 10.2 |
| 25,000 to 49,999 | 340 | 16.6 | 12,301,000 | 10.4 | 380 | 18.0 | 13,364,000 | 13.3 |
| 50,000 to 99,999 | 298 | 14.6 | 20,939,000 | 17.6 | 290 | 13.7 | 20,726,000 | 20.6 |
| 100,000 to 199,999 | 205 | 10.0 | 27,745,000 | 23.4 | 161 | 7.6 | 22,147,000 | 22.0 |
| 200,000 to 299,999 | 54 | 2.6 | 13,040,000 | 11.0 | 39 | 1.9 | 9,349,000 | 9.3 |
| 300,000 to 399,999 | 23 | 1.1 | 8,068,000 | 6.8 | 17 | .8 | 5,774,000 | 5.7 |
| 400,000 to 499,999 | 9 | .4 | 4,043,000 | 3.4 | 10 | .5 | 4,406,000 | 4.4 |
| 500,000 to 599,999 | 5 | .3 | 2,703,000 | 2.3 | 11 | .5 | 5,892,000 | 5.8 |
| 600,000 to 699,999 | 9 | .4 | 5,837,000 | 4.9 | 1 | (3) | 658,000 | .6 |
| 700,000 to 799,999 | 5 | .3 | 3,801,000 | 3.2 | 3 | .1 | 2,123,000 | 2.1 |
| 800,000 to 899,999 | 2 | .1 | | | 4 | .2 | | |
| 900,000 to 999,999 | | | [4] 11,225,000 | 9.4 | 1 | (3) | [4] 4,382,000 | 4.3 |
| 1,000,000 to 1,999,999 | 2 | .1 | | | 1 | .1 | 1,698,000 | 1.7 |
| 2,000,000 and over | 2 | .1 | | | | | | |
| | 2,048 | 100.0 | 118,783,000 | 100.0 | 2,113 | 100.0 | 100,819,000 | 100.0 |

[1] Plants operated by or for States, counties, and municipalities are not included; also not included are 194 railroad plants with an output of 6,559,000 short tons of sand and gravel in 1937 and 186 plants with an output of 4,941,000 tons in 1938.

[2] May include a few companies operating more than 1 plant but not submitting separate returns for individual plants.

[3] Less than 0.1 percent.

[4] Combined to avoid revealing production of individual plants.

## PRICES

Despite the drop in demand for sand and gravel for all important uses in 1938, prices changed little from those in 1937. The average value per ton, f. o. b. plant, of all sand and gravel reported by commercial producers fell only 3 percent—from $0.63 in 1937 to $0.61 in 1938. The sharpest decrease was in the value of filter sand and miscellaneous gravel, although engine and building sand as well as building and railroad ballast gravel also declined. The value of sand sold for various other purposes increased moderately, while that of paving gravel was unchanged.

Wholesale price indexes for sand and gravel, compiled by the Bureau of Labor Statistics from returns from about 30 plants throughout the United States, confirm the moderate decreases indicated by reports of producers to the Bureau of Mines. The price index of building sand (1926=100) declined only slightly, from 102.5 in 1937 to 102.1 in 1938, and that of gravel dropped from 94.2 to 93.2. These indexes are particularly significant when compared with other prices. The index



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for all building materials dropped from 95.2 in 1937 to 90.3 in 1938, and the general index for all commodities slumped from 86.3 to 78.6.

This relative stability of sand and gravel prices, despite declining prices for virtually all other commodities, was an outstanding feature of the industry in 1938.

## NEW DEVELOPMENTS

Notwithstanding the drop in output in 1938, construction of new sand and gravel plants and remodeling of old plants through the installation of new equipment kept pace with 1937.[1] No outstandingly large plants were built in 1938; most of the new operations are designed to serve relatively small market areas, and some have facilities only for truck shipments. Many plants have been rebuilt, not so much to increase capacity or effect economies as to fill the demand for materials to meet new and changing specifications. As a matter of fact, the necessity for producing additional sizes of aggregates in many instances actually may have resulted in an increase in operating costs.[2] Several plants are now splitting their sand output into two or more size fractions and recombining them to meet varying specifications.

The National Sand and Gravel Research Foundation was established at the University of Maryland early in 1938. Modern equipment includes machines for strength tests of concrete and other materials, devices for abrasion tests of aggregates, a constant-temperature room, and other smaller equipment commonly found in construction-materials testing laboratories.

A preliminary study involving determination of the modulus of elasticity of concrete by sonic vibrations is being carried on in cooperation with the Eastern Experiment Station of the Bureau of Mines. This investigation may lead to a wider use of concrete in mine structures, will provide additional valuable information on the modulus of elasticity of concrete, and may point the way to further studies of the soundness of concrete and aggregates. Under way also are an investigation of the mortar-making characteristics of sand, continuation of the study of the adhesion of bitumens to aggregates, and a general study of the physical characteristics of miscellaneous aggregates.

## FOREIGN TRADE[3]

Imports of sand and gravel increased in 1938, but, as in 1937, the entire gain was in the movement of construction materials from Canada. Imports of glass sand, virtually all from Belgium and consigned to the Pacific coast glass industry, decreased 34 percent.

Exports of sand and gravel dropped sharply, but the quantity of material involved is so small that they are of little consequence.

[1] Pit and Quarry, Sand and Gravel Benefits From Growing Construction Volume: Vol. 31, No. 7, January 1939, pp. 65–70

[2] Nordberg, Brov, Demands for New Products Require Plant Changes: Rock Products, vol. 42, No. 1, January 1939, pp. 38–41.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Sand and gravel imported for consumption in the United States, 1936–38, by classes*

| Class | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Glass sand [1] | 52,944 | $117,706 | 51,090 | $79,112 | 33,889 | $68,315 |
| Other sand [2] | 124,013 | 62,193 | 319,134 | 134,430 | 611,468 | 157,992 |
| Gravel | 201,398 | 38,142 | 163,406 | 36,193 | 55,619 | 22,902 |
| | 378,355 | 218,041 | 533,630 | 249,735 | 700,976 | 249,209 |

[1] Classification reads "Sand containing 95 percent silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."
[2] Classification reads "Sand, n. s. p. f."

*Sand and gravel imported into the United States, 1936–38, by countries*

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| North America: | | | | | | |
| Canada | 322,091 | $80,508 | 474,394 | $142,828 | 655,742 | $160,707 |
| Mexico | 22 | 5 | | | 22 | 220 |
| Other North America | | | 32 | 53 | | |
| Europe: | | | | | | |
| Belgium | 51,039 | 111,246 | 55,371 | 80,248 | 34,444 | 68,810 |
| France | 223 | 1,840 | 269 | 1,774 | 585 | 1,477 |
| Germany | 190 | 2,328 | 1,101 | 12,640 | 2,503 | 10,219 |
| Netherlands | 931 | 12,135 | 302 | 3,224 | [1] | 28 |
| United Kingdom | 3,859 | 9,979 | 1,655 | 8,506 | 7,572 | 6,827 |
| Asia: Japan | | | 2 | 12 | | |
| Oceania: Australia | | | 504 | 450 | 108 | 921 |
| | 378,355 | 218,041 | 533,630 | 249,735 | 700,976 | 249,209 |

[1] Less than 1 ton.

*Sand and gravel exported from the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 33,550 | $41,649 | 1937 | 67,141 | $80,197 |
| 1935 | 37,393 | 26,369 | 1938 | 35,572 | 30,303 |
| 1936 | 49,906 | 58,453 | | | |

## BLAST-FURNACE SLAG

The principal material competing with gravel is crushed stone, statistics for which appear in the Stone chapter of this and previous volumes of the Minerals Yearbook and Mineral Resources series. Blast-furnace slag is also important in the same markets in some areas.

In 1938, for the first time, the National Slag Association canvassed 34 companies operating 70 plants engaged in preparing blast-furnace slag for market. The total output of air-cooled and granulated slag was 7,978,066 tons valued at $6,246,615. This quantity was equivalent to 14 percent of the total commercial-gravel production. The following tables give detailed statistics of blast-furnace slag sold or used by producers in the United States in 1938, by regions and by uses.

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*Blast-furnace slag sold or used by producers in the United States in 1938, by regions* [1]

| Region | Air-cooled | | | Granulated | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average | | Total | Average |
| A—New York, Pennsylvania, and Maryland | 1,965,913 | $1,837,954 | $0.93 | 442,280 | $43,731 | $0.10 |
| B—Kentucky, Ohio, and West Virginia | 2,848,877 | 2,734,477 | .96 | 214,527 | 34,992 | .16 |
| C—Tennessee and Alabama | 1,945,217 | 1,219,924 | .63 | | | |
| D—Illinois, Indiana, and States west of the Mississippi | 561,252 | 375,537 | .67 | | | |
| Total United States | 7,321,259 | 6,167,892 | .84 | 656,807 | 78,723 | .12 |

[1] National Slag Association.

*Blast-furnace slag sold or used by producers in the United States in 1938, by uses* [1]

| Use | Air-cooled | | | Granulated | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average | | Total | Average |
| Concrete (roads, paving, building, etc.) | 1,486,538 | $1,326,647 | $0.89 | | | |
| Roads other than concrete | 3,719,791 | 3,648,700 | .98 | | | |
| Fills, sub-bases, cushion courses, etc. | 277,251 | 129,913 | .47 | 624,753 | $53,928 | $0.09 |
| Railroad ballast | 1,510,279 | 795,467 | .53 | | | |
| Roofing | 54,980 | 76,772 | 1.40 | | | |
| Sewage trickle filter | 35,687 | 38,613 | 1.08 | | | |
| Agricultural purposes | 6,002 | 3,600 | .60 | 28,554 | 23,045 | .81 |
| Mineral wool | 45,936 | 41,902 | .91 | | | |
| Screenings (use not given) | 161,399 | 63,971 | .40 | | | |
| Other uses | 23,396 | 42,307 | 1.81 | 3,500 | 1,750 | .50 |
| Total United States | 7,321,259 | 6,167,892 | .84 | 656,807 | 78,723 | .12 |

[1] National Slag Association.

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# GYPSUM

By Forrest T. Moyer

## SUMMARY OUTLINE


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Activity in the gypsum industry was generally slower in 1938 than in 1937, as is illustrated by the 7-percent decrease in value of total sales of gypsum products. Although 1937 was the best year for the industry since 1932, depressing influences prevailing at its close carried over into the early part of 1938, and the progressive recovery during the second and third quarters of 1938 was little more than seasonal. Not until the fourth quarter was improvement definitely under way, and this was the only period in which sales of gypsum products gained over those in the corresponding quarter of 1937.

Of outstanding interest was the continued climb in sales of gypsum lath to a new high record. The present uptrend in consumption of this product began in 1935 and continued through 1938. It is significant that, as measured by the usual sales units (square feet for gypsum boards and short tons for plasters), lath is the only gypsum building product for which Bureau of Mines figures indicate an increase over 1937.

More active development of markets in the Southeastern States is indicated by the erection of processing mills by two gypsum companies. These mills, one in Georgia and one in Florida, began production of a complete line of gypsum products in the early part of 1939. They use crude gypsum imported from Canada. Formerly this area contained only two gypsum plants, one in Florida and the other in southwest Virginia. The large increase in productive capacity should promote larger consumption of gypsum products in the South.

The general welfare of the gypsum industry depends on building construction, which annually consumes more than 90 percent of the total value of all gypsum products sold or used in the country. As shown by data of the F. W. Dodge Corporation, the value of residential and nonresidential building contracts awarded in 1938 was virtually unchanged from that in 1937. Although building activity rose more or less steadily from the relatively low level that prevailed at the close of 1937, the gypsum industry in 1938 did not enjoy the full benefit of the indicated increase because of the lag of possibly 3 or 4 months between the time of contract award and the purchase of gypsum products. Consequently, much of the increased business



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forecast by the growing volume of building contracts during the latter part of 1938 did not reach the gypsum producer until the first half of 1939.

*Salient statistics on the gypsum industry in the United States, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Active establishments [1] | 82 | 81 | 84 | 92 | 90 |
| Crude gypsum: | | | | | |
| Mined, short tons | 1,536,170 | 1,903,880 | 2,712,510 | 3,058,166 | 2,684,205 |
| Imported, do | 360,186 | 450,250 | 676,990 | 897,484 | 789,429 |
| Apparent supply, do | 1,896,356 | 2,354,130 | 3,389,500 | [2] 3,955,650 | [2] 3,473,634 |
| Calcined gypsum produced: | | | | | |
| Short tons | [3] | 1,383,093 | [3] | [4] 2,411,362 | [4] 2,252,878 |
| Value | [3] | [3] | [3] | [4] $11,076,205 | [4] $10,989,626 |
| Gypsum products sold: [5] | | | | | |
| Uncalcined: | | | | | |
| Short tons | 578,947 | 595,130 | 830,683 | [4] 860,825 | [4] 756,565 |
| Value | $1,266,945 | $1,329,140 | $1,865,673 | [4] $1,920,706 | [4] $1,681,371 |
| Calcined: | | | | | |
| Short tons | 1,140,590 | 1,552,968 | 2,210,338 | [4] [6] 2,643,075 | [4] 2,556,296 |
| Value | $16,184,459 | $22,358,005 | $31,088,885 | [4] [6] $36,879,814 | [4] $34,574,937 |
| Total value | $17,451,404 | $23,687,145 | $32,954,558 | [4] [6] $38,800,520 | [4] $36,256,308 |
| Gypsum and gypsum products: | | | | | |
| Imported for consumption | $414,377 | $512,102 | $718,378 | $964,048 | $832,357 |
| Exported | $133,492 | $186,196 | $255,903 | $271,142 | $282,782 |

[1] Each mine, plant, or combination mine and plant is counted as 1 establishment; beginning in 1937 plants utilizing byproduct gypsum are included.
[2] To avoid revealing confidential data, byproduct gypsum is excluded.
[3] Data not collected.
[4] Includes byproduct gypsum.
[5] Gypsum products from domestic and imported crude.
[6] Revised figures.

The accompanying table of salient statistics shows moderate declines for all phases of the gypsum industry in 1938 compared with 1937, except the limited export trade, which increased slightly in value. The drop from 1937 of 482,016 short tons (12 percent) in the apparent supply of crude gypsum was shared equally by domestic mines and importations. This proportional decrease in tonnage from both sources indicates the balanced relationship in 1938 between the utilized capacity of plants processing imported material and those using domestic crude. The decreases of 7 percent in the quantity of calcined gypsum produced (kettle and kiln output) and the value of all products sold or used, compared with 1937, give a more accurate picture of the condition of the industry in 1938 than that indicated by the greater decline in the crude supply. Sales of uncalcined products fell 12 percent below 1937 in both tonnage and value; but sales of calcined products, which constitute the major part of the gypsum business, declined only 3 percent in tonnage and 6 percent in value. This greater decrease in value was due to the lowering of the prices of several types of calcined gypsum products. The value of all gypsum and gypsum products imported during 1938 again exceeded the value of exports by approximately 3 to 1, chiefly because of the large tonnage of crude gypsum imported for processing into products.

## DOMESTIC PRODUCTION

Domestic supplies of crude gypsum were obtained from 56 active operations including 28 underground mines, 22 quarries, and 6 combinations of underground mines and quarries. Operations were

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active in 16 States throughout the country; New York had the greatest number. As shown in the following table, production declined from 1937 in all of the States except Nevada and Montana where slight gains were recorded. Ranking States in order of tonnage were New York, Michigan, Iowa, and Texas. Underground mining, which is common practice in the East and Middle West, produced more than half the domestic crude supply in 1938.

*Crude gypsum mined in the United States, 1936–38, by States*

| State | 1936 [1] | | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|---|---|
| | Active mines | Short tons | Active mines | Short tons | Value | Active mines | Short tons | Value |
| California | 5 | 142,853 | 5 | 186,158 | $355,834 | 5 | 162,056 | $334,208 |
| Colorado | 4 | 27,424 | 3 | 28,586 | 50,034 | 3 | 21,591 | 41,080 |
| Iowa | 8 | 344,221 | 8 | 387,255 | 533,162 | 8 | 364,920 | 495,856 |
| Michigan | 5 | 496,611 | 5 | 553,242 | 896,947 | 5 | 483,324 | 775,908 |
| Nevada | 3 | 167,342 | 3 | 160,347 | 268,638 | 3 | 168,515 | 366,869 |
| New York | 10 | 609,204 | 10 | 700,357 | 1,107,175 | 10 | 601,394 | 941,744 |
| Oklahoma | 4 | 156,545 | 4 | 159,639 | 266,091 | 3 | 141,341 | 231,910 |
| Texas | 5 | 257,773 | 5 | 280,807 | 313,563 | 5 | 246,990 | 260,094 |
| Utah | 3 | 40,275 | 3 | 46,197 | 46,197 | 3 | 43,144 | 45,823 |
| Other States [2] | 12 | 470,262 | 12 | 555,578 | 944,862 | 11 | 450,930 | 778,182 |
| | 59 | 2,712,510 | 58 | 3,058,166 | 4,782,503 | 56 | 2,684,205 | 4,271,674 |

[1] Value of crude gypsum mined not available.
[2] 1936–37: 1 active mine each in Arizona, Idaho, South Dakota, and Wyoming; 2 each in Kansas, Montana, Ohio, and Virginia. 1938: 1 active mine each in Idaho, South Dakota, and Wyoming; 2 each in Kansas, Montana, Ohio, and Virginia.

The value of the run-of-mine gypsum reported in the table is estimated by the producers, and as there is no open market for this material the figure is presumably a so-called "transfer value," which may represent only the actual cost of mining (including depreciation, depletion, etc.). In some instances the value returned by a producer may be only an estimate of a probable open-market price for the material. In 1938 the average value returned by producers was $1.59 per ton. The data on natural crude gypsum do not include the tonnage and value of crude byproduct gypsum utilized.

*Number of active calcining plants, kettles, and rotary kilns in the United States, 1936–38, by States*

| State | 1936 | | | 1937 [1] | | | 1938 [1] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Calcining plants | Kettles | Rotary kilns | Calcining plants | Kettles | Rotary kilns | Calcining plants | Kettles | Rotary kilns |
| California | 3 | 9 | -- | 3 | 10 | -- | 3 | 10 | -- |
| Iowa | 5 | 19 | -- | 5 | 19 | -- | 6 | 21 | -- |
| Michigan | 5 | 22 | -- | 5 | 22 | -- | 5 | 22 | -- |
| New York | 8 | 28 | 7 | 8 | 24 | 8 | 8 | 26 | 8 |
| Texas | 4 | 30 | -- | 4 | 30 | -- | 4 | 29 | -- |
| Utah | 3 | [3] 9 | -- | 3 | 6 | -- | 3 | [3] 8 | -- |
| Other States [4] | 23 | [5] 62 | 9 | 26 | [5] 72 | 10 | 25 | [5] 67 | 8 |
| | 51 | [3] [5] 179 | 16 | 54 | [5] 183 | 18 | 54 | [3] [5] 183 | 16 |

[1] Includes plants and equipment for calcining byproduct gypsum.
[2] Includes 3 vertical kilns.
[3] Includes 2 beehive kilns.
[4] 1936: 1 calcining plant each in Arizona, Connecticut, Indiana, Massachusetts, Nevada, New Hampshire, New Jersey, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, Ohio, Oklahoma, and Virginia. 1937: 1 calcining plant each in Arizona, Connecticut, Florida, Illinois, Indiana, Massachusetts, Nevada, New Hampshire, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, New Jersey, Ohio, Oklahoma, and Virginia. 1938: 1 calcining plant each in Arizona, Connecticut, Florida, Illinois, Indiana, Massachusetts, Nevada, New Hampshire, Oklahoma, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, New Jersey, Ohio, and Virginia.
[5] Includes 4 beehive kilns.

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The foregoing table shows that calcining plants were operated in 25 States during 1938. There were 54 active plants, and of these 41 operated on domestic crude, 11 on imported, and 2 on crude byproduct gypsum. Two plants, one using domestic and the other using by-product material, were abandoned in the latter part of the year.

## DISTRIBUTION OF SALES

In 1938 sales of the three general groups of gypsum products—uncalcined, calcined building, and calcined industrial—declined in both quantity and value from 1937 figures. Gypsum sold for use as portland-cement retarder, which constitutes by far the greater part of all raw or uncalcined shipments, fell 12 percent in tonnage and 15 percent in value below 1937. The average value per ton (f. o. b. plant) for this material declined 6 cents from the 1937 figure to $1.84 per ton in 1938. Sales of agricultural gypsum, used chiefly by the peanut growers of Virginia and to correct alkali soils, declined more in quantity (9 percent) than in value (4 percent). A slight increase in the use of finely ground uncalcined products such as fillers is indicated by the rise in the average value per ton of sales for "Other uses" from $7.93 in 1937 to $8.84 in 1938.

Sales of calcined building products declined only 2 percent in quantity from 1937, because increases in the gross tonnages of gypsum-lath and wallboard sales nearly balanced the weight losses of plasters and tile. However, the total value of this group of products fell 6 percent below 1937, on account of decreases in the average value per unit of gauging, molding, and package plasters, as well as gypsum board. Plasters (fibered and unfibered) sold for use in base-coat work, which comprise the largest tonnage of calcined building products, declined 10 percent in quantity and 11 percent in value from 1937. In contrast, sales of gauging and molding plasters, which are used in the finishing coat, fell only 2 percent in tonnage but 6 percent in value from 1937. The greater proportional decline in tonnage of base-coat plasters may be explained by the increased use of gypsum lath on which there appears to be an unfortunate tendency to use thin scratch and brown coats or to eliminate entirely the brown coat. Sales of the class "Other plasters," which is composed largely of the so-called package plasters sold in small units, showed a large decline of $14.03 in the average value per ton from 1937. As shown in the following table, sales of the remaining classes of building plasters and Keene's cement declined various amounts from the 1937 figures. The rather high declines of 16 percent in both square footage and value of sales of all tile (partition, roofing, soffit, etc.) probably resulted from the relatively small total of commercial and industrial building during 1938.

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*Gypsum products made from domestic, imported, and byproduct crude gypsum sold or used in the United States, 1937–38, by uses*

| Use | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Uncalcined: | | | | |
| Portland cement retarder | 770,004 | $1,462,469 | 674,062 | $1,238,715 |
| Agricultural gypsum | 74,932 | 332,248 | 68,470 | 318,620 |
| Other uses [1] | 15,889 | 125,989 | 14,033 | 124,036 |
| Total uncalcined | 860,825 | 1,920,706 | 756,565 | 1,681,371 |
| Calcined: | | | | |
| For building uses: | | | | |
| Plasters: | | | | |
| Base-coat | 1,288,539 | 11,621,507 | 1,161,762 | 10,400,557 |
| Sanded | 129,029 | 748,553 | 106,355 | 606,060 |
| To mixing plants | 24,532 | 144,565 | 16,917 | 102,821 |
| Gauging and molding | 123,292 | 1,527,764 | 120,933 | 1,442,511 |
| Prepared finishes | 29,291 | 568,404 | 26,424 | 488,307 |
| Insulating and roof-deck | 24,658 | 215,419 | 16,233 | 143,877 |
| Other [2] | 15,549 | 653,179 | 12,843 | 359,309 |
| Keene's cement | [3] 34,260 | [3] 530,863 | 23,496 | 366,813 |
| Lath [4] | 469,970 | 9,604,372 | 594,659 | 10,287,935 |
| Wallboard [5] | 241,096 | 8,349,810 | 269,949 | 7,921,400 |
| Tile [6] | 137,006 | 1,552,248 | 112,477 | 1,300,830 |
| Total for building uses | [3] 2,517,222 | [3] 35,516,684 | 2,462,048 | 33,420,420 |
| For manufacturing uses: | | | | |
| To plate-glass and terra-cotta works | 60,620 | 466,803 | 21,918 | 144,845 |
| To pottery works | 19,415 | 254,532 | 16,981 | 219,071 |
| Orthopedic and dental plasters | (7) | (7) | 8,114 | 270,691 |
| For other manufacturing uses [8] | 45,818 | 641,795 | 47,235 | 519,910 |
| Total for manufacturing uses | 125,853 | 1,363,130 | 94,248 | 1,154,517 |
| Total calcined | [3] 2,643,075 | [3] 36,879,814 | 2,556,296 | 34,574,937 |
| Grand total value | ---------- | [3] 38,800,520 | ---------- | 36,256,308 |

[1] Includes uncalcined gypsum sold for use as filler and rock dust, in paint manufacturing, and for minor purposes.
[2] Includes joint filler, patching and painter's plaster, and unclassified building plasters.
[3] Revised figures.
[4] 1937: 738,928,559 square feet; 1938: 809,470,931 square feet.
[5] 1937: 385,306,845 square feet; 1938: 371,766,937 square feet.
[6] 1937: 23,819,738 square feet; 1938: 19,941,993 square feet.
[7] Included under "For other manufacturing uses."
[8] Includes in 1937, orthopedic, dental, statuary, industrial molding and casting plasters, dead-burned filler, and miscellaneous sales; in 1938, statuary, industrial casting and molding plasters, dead-burned filler, and miscellaneous sales.

In 1938 total shipments of calcined products used in manufacturing processes declined 25 percent in quantity and 15 percent in value from 1937. The greatest decrease was in calcined gypsum sold to the plate-glass and terra-cotta industries and was occasioned by the low levels at which these industries operated until near the end of 1938.

The square footage of gypsum-lath sales rose to a new record during 1938, increasing 10 percent over 1937. This increase was accompanied by a decrease in unit value of 29 cents from 1937 to a sales value (f. o. b. plant) of $12.71 per thousand square feet in 1938. Both the square footage and total value of wallboard shipments dropped below 1937 figures, and the average value per thousand square feet decreased slightly. The gross tonnages of sales of both lath and wallboard, which are estimated by the producers, showed substantial gains over 1937. These gains indicate either an increase in average weight per thousand square feet or increased sales of the thicker sizes of both types of board. The average number of square feet per ton in 1938

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was 1,361 for lath and 1,377 for wallboard as contrasted with corresponding figures for 1937 of 1,572 and 1,598.

Figure 1 shows the phenomenal expansion in sales of gypsum lath since 1928, the first year for which data are available. In the figure the square footage of lath and wallboard sold by selected companies and the total tonnage of all calcined gypsum building products are compared with the total floor area in square feet of all residential and nonresidential building contracts as reported by the F. W. Dodge Corporation. As these two general types of construction consume nearly all of the gypsum building products, their total floor area affords a reasonable basis for comparison. The sales of gypsum lath and wallboard by the selected companies represent approximately 90 and 95 percent respectively of the total annual sales of these products in the United States. The total tonnages of all calcined

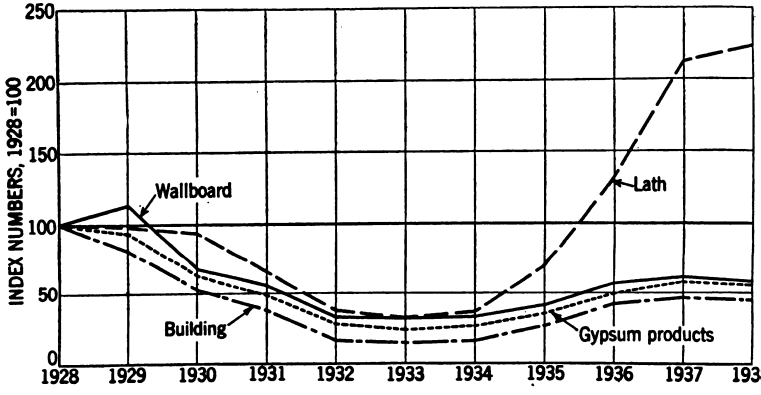


FIGURE 1.—Sales (square feet) of gypsum lath and wallboard by selected companies compared with total sales (short tons) of all calcined gypsum building products and total floor area (square feet) of residential and nonresidential building, 1928-38. Index numbers on building computed from F. W. Dodge Corporation data.

building products for 1937 and 1938 were adjusted for canvass changes so as to be comparable with preceding years.

The growing preference for gypsum lath over other types in the late twenties is shown clearly by the resistance in volume of sales of this product to the rapid decline in building activity after 1928. From 1931 to 1934 construction was virtually stagnant, and sales of lath followed the general trend of building. Beginning with 1935 gypsum lath became increasingly popular, and the volume of sales advanced rapidly. Thus, in 1938, when the total floor area of residential and nonresidential building was less than one-half the 1928 figure, the volume of sales of gypsum lath was 2¼ times greater than in 1928. The gain in 1938 over 1937 was smaller than that for the 2 preceding years but was accomplished despite a general decline in the volumes (measured as square feet for lath and wallboard, and short tons for plasters) of all other types of gypsum building products sold.

The great increase in sales of gypsum lath during 1935 and 1936 apparently resulted from a strong natural demand for lath, as the new price series of the Bureau of Labor Statistics shows that it developed without appreciable price reductions. The average wholesale price

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(f. o. b. cars at destination) for standard ⅜-inch gypsum lath from 1928 to 1936 ranged between $17.18 and $18.19 per thousand square feet. A reduction to $15.87 per thousand square feet undoubtedly aided the expansion in lath sales during 1937, and a further drop in price to $15.23 per thousand square feet in 1938 was an added stimulus.

In contrast to the sales of gypsum lath, trend lines of the sales of wallboard and all gypsum building products have followed closely that of building. The great expansion in sales of lath would be expected to exert a greater influence on the total tonnage of all calcined building products than is shown in figure 1. Its failure to do so probably is caused by several factors. The first is that the quantity unit applied to lath is the square foot, and this unit is more accurate than the gross tonnages of lath, which represent mere estimates by the producers. Thus errors may be introduced in the change from one unit to another. The second is that the growing practice of using thinner plaster coats on gypsum lath than on the other types reduces for a given area the quantity of base-coat and ready-sanded plasters used and thus tends to counteract the increase in weight of lath sold. A third factor is the small but growing use of prefabricated finished wall surfaces, such as sheet-metal partitions, wood paneling, fiberboards, and plywood. This practice reduces the total wall area of building that normally requires the application of plasters and may have reduced consumption of gypsum plasters to such an extent as to counterbalance the increased weight of lath sold.

## RECENT DEVELOPMENTS

In the latter part of 1938, construction was started on two new gypsum-processing plants, one in Georgia and the other in Florida. They will utilize imported crude rock. During the year three independent one-plant companies, one each in Kansas, New York, and Utah, were merged with large multiple-plant companies. Operations ceased at the New York plant, which was dismantled immediately after it was purchased. In Illinois a plant using crude byproduct gypsum was closed permanently. A large producer of building materials entered the gypsum industry during the year, gaining control of an independent company in Ohio and obtaining an excess-capacity agreement with one of the principal gypsum producers.

Fresh interest was aroused in the drying and grinding of crude gypsum as a single operation when a hammer-type mill designed for this purpose was installed in one of the new processing plants under construction in the Southeast. It is understood that at least one producing company is experimenting with the drying, grinding, and calcining of gypsum as a single operation in a hammer-type mill. This process would eliminate two of the three steps that are necessary with the conventional equipment of gypsum-processing plants.

An outstanding development during 1938 was the introduction of a patented machine that will perforate gypsum lath by punching the holes through a single thickness of board. The machine, which operates continuously, is said to yield the best results when perforating lath directly before the cutting knife. If the operation is as successful as reported for the first installations, the standard method of bundling the lath and drilling the holes with a battery of augers probably will be replaced within a short time.

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Results of a comprehensive study [1] of the heats of hydration and the transitions of the various forms of calcium sulfate were published by the Bureau of Standards. Investigations [2] by the same organization on the suitability of several types of lath as plaster bases and on the methods of plaster application are of interest to gypsum producers.

The Bureau of Mines published a description [3] of the occurrence, mining, and processing of gypsum in the United States. The report includes general information on anhydrite, which is closely related to gypsum.

## FOREIGN TRADE [4]

*Imports.*—The bulk of the imports of gypsum consists of crude rock, which enters the United States at certain New England, Middle Atlantic, Florida, and California ports. Although this material has a low average value per ton ($0.98 c. i. f. shipping port), such large quantities are imported that its total value comprised 93 percent of the total value of gypsum imports in 1938. Approximately 90 percent of the crude tonnage imported is processed into finished calcined-gypsum products at plants on tidewater near centers of consumption. Of the remaining tonnage, slightly more than half is ground and sold as agricultural gypsum, and the balance is consumed chiefly as retarder for portland cement.

The total value (c. i. f. shipping port) of gypsum imports during 1938 declined nearly 14 percent compared with 1937. All classes exhibited decreases of varying proportions except calcined, which increased slightly in tonnage and decreased in value. Crude gypsum imported during 1938 decreased 12 percent in quantity and 10 percent in value from 1937. Of the tonnage of crude material imported in 1938, tidewater quarries in Nova Scotia and New Brunswick, Canada, furnished 94 percent, and nearly all of the remainder came from San Marcos Island, Baja California, Mexico. The small tonnage from Italy evidently was composed largely of blocks of alabaster, which is used for carving art objects. The following tables show imports of gypsum and gypsum products in recent years.

*Gypsum imported for consumption in the United States, 1934–38*

| Year | Crude | | Ground | | Calcined | | Other manufactures n. e. s. | Keene's cement | | Total value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | | Short tons | Value | |
| 1934 | 360,186 | $371,082 | 1,085 | $14,880 | 534 | $10,890 | $16,859 | 27 | $666 | $414,377 |
| 1935 | 450,250 | 463,050 | 1,241 | 15,440 | 601 | 11,364 | 20,958 | 64 | 1,290 | 512,102 |
| 1936 | [1] 676,990 | [1] 657,125 | 1,374 | 16,937 | 450 | 8,778 | 34,722 | 20 | 816 | 718,378 |
| 1937 | [1] 897,484 | [1] 854,835 | 1,711 | 22,165 | 353 | 7,917 | 78,456 | 25 | 675 | 964,048 |
| 1938 | [1] 789,429 | [1] 772,026 | 1,486 | 17,674 | 372 | 7,649 | 34,878 | 6 | 130 | 832,357 |

[1] Includes anhydrite.

[1] Newman, E. S., and Wells, L. S., Heats of Hydration and Transition of Calcium Sulfate: Nat. Bureau of Standards, Jour. Research, vol. 20, No. 6, 1938, pp. 825–836.

[2] Wells, L. S., and Smith, D. C., Suitability of Fiber Insulating Lath as a Plaster Base: Nat. Bureau of Standards, Rept. BMS 3, 1938, 17 pp.

[3] Moyer, F. T., Gypsum and Anhydrite: Bureau of Mines Inf. Circ. 7049, 1939, 45 pp.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Crude gypsum (including anhydrite) imported for consumption in the United States, 1936–38, by countries*

| Country | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Canada | 631,340 | $613,052 | 838,106 | $797,157 | 739,172 | $723,780 |
| Hong Kong | 1 | 24 | | | | |
| Italy | 185 | 3,879 | 207 | 4,337 | 124 | 2,943 |
| Mexico | 45,464 | 40,170 | 59,166 | 53,146 | 50,133 | 45,303 |
| United Kingdom | | | 5 | 195 | | |
| | 676,990 | 657,125 | 897,484 | 854,835 | 789,429 | 772,026 |

*Exports.*—The total value of all gypsum and gypsum products exported from the United States in 1938 increased slightly over that in 1937. The following table shows that decreased shipments of raw gypsum and gypsum board were more than balanced by increases in the other classes of gypsum products exported.

*Gypsum and gypsum products exported from the United States, 1934–38*

| Year | Crude, crushed, or ground | | Plasterboard and wallboard | | Plaster, calcined, and manufactures | | Other manufactures, n. e. s. | Total value |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Square feet | Value | Short tons | Value | | |
| 1934 | 2,588 | $11,652 | 1,895,700 | $43,041 | [1] 2,264 | [1] $78,799 | [2] | $133,492 |
| 1935 | 4,528 | 15,473 | 1,929,348 | 42,465 | [1] 4,717 | [1] 128,258 | [2] | 186,196 |
| 1936 | [3] | [3] | [3] | [3] | [3] | [3] | [3] | 255,903 |
| 1937 | 4,777 | 26,692 | 4,360,404 | 96,019 | 2,847 | 61,383 | $87,048 | 271,142 |
| 1938 | 2,844 | 17,762 | 3,658,647 | 88,822 | 3,833 | 71,914 | 104,284 | 282,782 |

[1] Includes "Other manufactures, n. e. s."
[2] Not separately classified previous to 1937; included with "Plaster, calcined, and manufactures."
[3] Data not available; value reported as follows: "Crude, crushed, calcined, or ground," $107,732; "Plasterboard, wallboard, plaster, and manufactures, n. e. s.," $148,171.

The formation [5] of a Government-controlled company to produce gypsum board at Riga, Latvia, is of interest to the export trade. This plant, with an average guaranteed capacity of 1,500,000 square feet of board per year, is said to be the first of its kind in continental Europe. The entire production is to be exported.

## WORLD PRODUCTION

The following table shows the world output of crude gypsum from 1934 to 1938, inclusive, insofar as data are available. The leading producing countries, in probable order of importance, are the United States, France, United Kingdom, Canada, Germany, and the U. S. S. R.

[5] National Bureau of Foreign and Domestic Commerce, Foreign Metals and Minerals: Circ. 18, October 12, 1938, p. 27.

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*World production of gypsum, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Algeria | 83,920 | 56,710 | 45,265 | 46,175 | [2] |
| Anglo-Egyptian Sudan | | | 2,997 | | [2] |
| Argentina [3] | 44,142 | 49,773 | 55,706 | [4] | [2] |
| Australia: | | | | | |
| New South Wales | 2,753 | 1,722 | 4,390 | 9,300 | [2] |
| South Australia | 76,449 | 103,909 | 108,871 | 117,985 | [2] |
| Victoria | 6,499 | 8,852 | 7,581 | 21,197 | [2] |
| Western Australia | 5,392 | 5,450 | 6,768 | 9,219 | [2] |
| Brazil [5] | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Canada | 447,507 | 510,262 | 763,044 | 1,044,231 | [6] |
| Chile | 10,901 | 26,151 | 22,674 | 24,080 | [2] |
| China | 67,720 | 68,000 | 68,800 | [4] | [2] |
| Cyprus [7] | 9,217 | 14,851 | 16,603 | 13,576 | 9,729 |
| Egypt | 149,713 | 190,666 | 256,211 | 253,641 | [2] |
| Eire | | | 6,096 | 11,647 | [2] |
| Estonia | 4,905 | 6,238 | 13,849 | 12,748 | [2] |
| France | 1,453,450 | 1,275,000 | 1,376,150 | 1,320,400 | [2] |
| Germany [8] | 810,000 | 855,000 | [4] | [4] | [2] |
| Austria [8] | 45,000 | 46,000 | 47,000 | 47,000 | [2] |
| Greece | 4,525 | 3,612 | 13,779 | 17,924 | [2] |
| India, British | 47,507 | 46,045 | 55,277 | 46,830 | [2] |
| Italy | 458,978 | 471,167 | 324,789 | 416,198 | [2] |
| Japan | [4] | 127,633 | 137,677 | [4] | [2] |
| Latvia [7] | 81,816 | 98,935 | 123,503 | 196,911 | 196,964 |
| Luxemburg | 10,689 | 29,474 | 29,110 | 19,722 | [2] |
| Mexico | [4] | 54,514 | 61,711 | [4] | [2] |
| New Caledonia | 13,585 | | | 984 | [2] |
| Palestine | 3,431 | 4,543 | 6,209 | 3,934 | 3,984 |
| Peru | 8,147 | 9,056 | 12,560 | 15,000 | [2] |
| Portugal | 20,315 | 4,800 | 6,850 | 11,390 | [2] |
| Rumania | 47,176 | 92,018 | 45,991 | 53,603 | [2] |
| Spain | 741,245 | [4] | [4] | [4] | [2] |
| Sweden | 121 | 170 | 93 | [4] | [2] |
| Tunisia | 15,550 | 11,000 | 11,200 | 22,800 | [2] |
| Union of South Africa | 23,296 | 21,590 | 31,962 | 33,186 | [2] |
| U. S. S. R. | 688,000 | [4] | [4] | [4] | [4] |
| United Kingdom | 977,014 | 997,673 | 1,018,562 | 1,111,669 | [2] |
| United States | 1,393,583 | 1,727,162 | 2,460,735 | 2,774,307 | 2,435,057 |
| | 7,900,000 | 8,300,000 | 9,400,000 | 10,300,000 | [2] |

[1] In addition to the countries listed, gypsum is produced in Cuba, Switzerland, and Yugoslavia, but production data are not available.
[2] Data not yet available.
[3] Rail and river shipments.
[4] Data not available; estimate included in total.
[5] Approximate production.
[6] Data for crude gypsum mined not available. Shipments of crude (lump, crushed, and ground) and calcined gypsum amounted to 924,587 tons.
[7] Exports of crude and calcined gypsum.
[8] Figures supplied by Deutscher Gips-Verein, E. V., Berlin, Germany. Figures are exclusive of rock gypsum mined and used by cement, paint, and other factories from their own quarries.
[9] Estimate furnished by Bundesministerium für Handel und Verkehr.

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# LIME

By Forrest T. Moyer and A. T. Coons

## SUMMARY OUTLINE


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The total quantity of lime (quick and hydrated) sold or used in the United States in 1938 was 19 percent lower than in 1937. Activity, which corresponded closely with average business conditions throughout the country, was depressed during the first half of the year but improved greatly in all branches of the industry during the latter half. However, these gains were insufficient to compensate for the earlier losses. The decrease in sales was accompanied by a slight decline in prices of nearly all types of lime. Sales of hydrated lime held up considerably better than those of quicklime, which fell 23 percent below 1937.

As reported by the operators, wages remained at approximately the same level as in 1937, although small local increases were noted. Labor difficulties, of which the most serious closed several large plants in the Middle West for nearly 6 months, occurred in scattered localities.

Because demand for all types of lime was low during the early months, total sales by general groups of uses in 1938 reflect the varying degrees of improvement that occurred in the consuming industries later in the year. The downtrend in building construction was among the first to be reversed, and activity in this industry increased steadily after the first quarter of the year. Dollar volume of contracts awarded for residential building, as reported by the F. W. Dodge Corporation, was nearly trebled from February to August and remained at a high level through December. Increased building of residences was aided to a large extent by the liberal mortgage-insurance policy of the Federal Housing Administration, which transacted a record volume of business. Likewise, the value of nonresidential building at the close of the year was nearly three times as great as it was in February. The subsidized-housing program of the Federal Government (United States Housing Authority), which was barely under way at the end of 1938, will be an important factor in the building industry during the first half of 1939. Despite the increase in contracts awarded, sales



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of building lime in 1938 were 10 percent below 1937. The failure of lime to keep pace with the increase in building is doubtless due partly to the fact that many contracts awarded toward the close of the year did not reach the actual construction stage until early in 1939. Furthermore, there is always a lag of 1 to 3 months between the time of contract award and the purchase of lime.

In close accord with the 11-percent decline in the total cash farm income in 1938, sales of agricultural lime in 1938 were 10 percent below those in 1937. Both lime and limestone are used on agricultural land, but the claim is made that lime, particularly in hydrated form, affords a closer control of acidity or alkalinity in the soil than unburned stone.

*Salient statistics of the lime industry in the United States, 1937–38*

| | 1937 | 1938 | Percent of change in 1938 |
|---|---|---|---|
| Lime sold or used by producers: | | | |
| Total lime: | | | |
| Short tons | 4,124,165 | 3,346,954 | −18.8 |
| Value | $30,091,168 | $24,137,638 | −19.8 |
| Per ton | $7.30 | $7.21 | −1.2 |
| Hydrated lime (included in total): | | | |
| Short tons | 1,301,333 | 1,169,804 | −10.1 |
| Value | $10,344,470 | $9,111,575 | −11.9 |
| Per ton | $7.95 | $7.79 | −2.0 |
| By uses: | | | |
| For building: | | | |
| Short tons | 948,553 | 854,461 | −9.9 |
| Value | $8,212,995 | $7,163,165 | −12.8 |
| Per ton | $8.66 | $8.38 | −3.2 |
| For agriculture: | | | |
| Short tons | 406,462 | 364,312 | −10.4 |
| Value | $2,738,433 | $2,376,108 | −13.2 |
| Per ton | $6.74 | $6.52 | −3.3 |
| For chemical uses (excluding dead-burned dolomite): | | | |
| Short tons | 2,151,444 | 1,761,555 | −18.1 |
| Value | $13,921,907 | $11,503,010 | −17.4 |
| Per ton | $6.47 | $6.53 | +.9 |
| Dead-burned dolomite: | | | |
| Short tons | 617,706 | 366,626 | −40.6 |
| Value | $5,217,833 | $3,095,355 | −40.7 |
| Per ton | $8.45 | $8.44 | −.1 |
| Imports for consumption: | | | |
| Quicklime and hydrated lime: | | | |
| Short tons | 8,788 | 6,818 | −22.4 |
| Value | $90,605 | $66,203 | −26.9 |
| Per ton | $10.31 | $9.71 | −5.8 |
| Dead-burned dolomite: | | | |
| Short tons | 9,083 | 2,875 | −68.3 |
| Value | $231,084 | $67,340 | −70.9 |
| Per ton | $25.44 | $23.42 | −7.9 |
| Exports (lime): | | | |
| Short tons | 11,300 | 13,222 | +17.0 |
| Value | $122,895 | $121,662 | −1.0 |
| Per ton | $10.88 | $9.20 | −15.4 |

Chemical uses of lime, as grouped by the Bureau of Mines, consumed 389,889 short tons less in 1938 than in 1937, a decline of 18 percent. Sales to the principal consuming industries of this group generally decreased from those in 1937 in varying proportions. An increase was noted only in sugar refining, which consumes a relatively small tonnage. The quantity of metallurgical lime sold or used showed the greatest decline—29 percent below 1937. This drop in consumption resulted chiefly from the low average levels of activity

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in the steel and copper industries. Nearly three-fourths of the total tonnage of metallurgical lime is used in making steel ingots, production of which in 1938, according to Federal Reserve Board data, was only 67 percent of the 1923–25 annual average contrasted with 119 percent in 1937. Approximately half of the remaining tonnage is consumed in the flotation of copper ores, and the total quantity of such ores treated in 1938 was lower than in 1937.

Sales of lime to the paper industry, the second largest consumer of chemical-grade lime, were 10 percent below 1937, reflecting a corresponding decrease in the total volume of all major types of paper produced. A substantial decline in plate-glass and glass-container production in 1938 was accompanied by a decrease of 24 percent in the quantity of lime used in glass manufacture.

In 1938 sales of dead-burned dolomite, for the first time since 1932, failed to show a gain over the preceding year and were 41 percent below the record volume of 1937. The tonnage decrease of this material, which is used mainly for open-hearth refractories, resulted from the low percentage of capacity at which steel plants operated during the year. Moreover, as implied by the record consumption in 1937, the furnaces probably were in good condition and required a minimum of repairs to the refractory linings. In this chapter data on dead-burned dolomite do not include the entire consumption in the United States, as some steel companies calcine dolomite purchased raw or obtained from their own quarries. Such tonnages, recorded in the chapter on Stone in this volume, decreased 54 percent from 1937.

For the first year since 1919 the total value of lime exports in 1938 nearly balanced the total value of imports for consumption. However, the export-import trade represents only a small fraction of the total lime business.

## PRODUCTION

The recovery of the lime industry from the economic depression of the early 1930's progressed steadily from 1932 to 1937, total sales in each year increasing over those of the preceding year in both quantity and value. In 1938, however, this upward movement was halted, and lime consumption fell below that of 1936. Data covering recent years are given in the following table.

*Lime sold or used by producers in the United States, 1934–38*

| Year | Plants in operation | Short tons [1] | Value [2] | |
|---|---|---|---|---|
| | | | Total [1] | Average |
| 1934 | 324 | 2,397,087 | $17,164,024 | $7.16 |
| 1935 | 301 | 2,987,133 | 21,748,655 | 7.28 |
| 1936 | 301 | 3,749,383 | 26,933,719 | 7.18 |
| 1937 | 314 | 4,124,165 | 30,091,168 | 7.30 |
| 1938 | 321 | 3,346,954 | 24,137,638 | 7.21 |

[1] Includes lime used by producers (captive tonnage) as follows—1934: 129,290 short tons valued at $671,864; 1935: 143,716 tons, $750,155; 1936: 224,693 tons, $1,179,820; 1937: 270,192 tons, $1,388,052; 1938: 168,245 tons, $985,003.

[2] Value given represents value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.



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*Production by States.*—As the following table shows, production of lime in most States was lower in 1938 than in 1937; the largest declines occurred in Missouri and West Virginia. Increased output was noted for several States, the largest being in Indiana, Maryland, and Tennessee. The production of lime in 1938 in the three leading States—Ohio, Pennsylvania, and Missouri—comprised 50 percent of the total output of the country.

*Lime sold or used by producers in the United States, 1937–38, by States*

| State | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Plants in operation | Short tons | Value | Plants in operation | Short tons | Value |
| Alabama | 8 | 176,085 | $964,400 | 9 | 151,937 | $911,033 |
| Arizona | 3 | 54,789 | 466,098 | 3 | 39,568 | 353,224 |
| Arkansas | 2 | (1) | (1) | 2 | (1) | (1) |
| California | 7 | 71,965 | 737,387 | 7 | 71,596 | 712,388 |
| Colorado | 4 | 7,163 | 72,831 | 3 | 9,564 | 95,207 |
| Connecticut | 1 | (1) | (1) | 1 | (1) | (1) |
| Florida | 3 | 19,008 | 177,929 | 3 | 19,638 | 185,286 |
| Georgia | 1 | 7,964 | 62,196 | 1 | 7,046 | 54,150 |
| Hawaii | 1 | 8,261 | 83,183 | 2 | (1) | (1) |
| Idaho | 1 | (1) | (1) | 1 | (1) | (1) |
| Illinois | 7 | 142,122 | 1,039,087 | 8 | 135,256 | 965,836 |
| Indiana | 7 | 94,053 | 552,243 | 6 | 102,054 | 581,922 |
| Kentucky | 1 | (1) | (1) | 1 | (1) | (1) |
| Maine | 2 | (1) | (1) | 2 | (1) | (1) |
| Maryland | 11 | 59,575 | 404,562 | 19 | 62,479 | 446,013 |
| Massachusetts | 6 | 101,247 | 897,356 | 6 | 91,453 | 741,975 |
| Michigan | 4 | 48,310 | 351,681 | 4 | 45,848 | 339,324 |
| Minnesota | 2 | (1) | (1) | 2 | (1) | (1) |
| Missouri | 10 | 426,514 | 2,326,928 | 10 | 298,151 | 1,724,140 |
| Montana | 3 | 13,295 | 79,201 | 2 | (1) | (1) |
| Nevada | 2 | (1) | (1) | 2 | (1) | (1) |
| New Jersey | 4 | 20,029 | 151,350 | 4 | 19,940 | 145,076 |
| New Mexico | 3 | 902 | 8,900 | 2 | (1) | (1) |
| New York | 9 | 55,947 | 438,151 | 8 | 39,439 | 302,360 |
| North Carolina | 1 | (1) | (1) | 1 | (1) | (1) |
| Ohio | 22 | 1,069,374 | 8,653,571 | 22 | 836,589 | 6,658,853 |
| Oklahoma | | | | 1 | (1) | (1) |
| Oregon | 2 | (1) | (1) | 2 | (1) | (1) |
| Pennsylvania | 95 | 692,935 | 5,117,733 | 99 | 532,066 | 3,784,462 |
| Puerto Rico | 4 | 4,723 | 39,909 | 3 | 2,953 | 23,554 |
| Rhode Island | 1 | (1) | (1) | 1 | (1) | (1) |
| South Carolina | 1 | (1) | (1) | | | |
| South Dakota | 2 | (1) | (1) | 2 | (1) | (1) |
| Tennessee | 10 | 157,440 | 909,839 | 10 | 162,661 | 901,460 |
| Texas | 7 | 49,135 | 440,069 | 7 | 49,352 | 429,664 |
| Utah | 9 | 46,670 | 319,517 | 7 | 25,748 | 184,390 |
| Vermont | 5 | 56,585 | 388,885 | 5 | 58,149 | 415,846 |
| Virginia | 24 | 192,493 | 1,248,479 | 24 | 161,687 | 1,014,607 |
| Washington | 5 | 65,272 | 647,692 | 5 | 34,025 | 348,332 |
| West Virginia | 12 | 250,205 | 1,617,040 | 12 | 163,064 | 1,003,559 |
| Wisconsin | 12 | 59,536 | 508,536 | 12 | 55,993 | 483,111 |
| Undistributed | | 172,568 | 1,386,415 | | 170,698 | 1,331,866 |
| | 314 | 4,124,165 | 30,091,168 | 321 | 3,346,954 | 24,137,638 |

[1] Included under "Undistributed."

*Hydrated lime.*—Despite a drop in the average value per ton, the quantity of hydrated lime sold or used in 1938 declined 10 percent from 1937. This was the first year since 1934 in which sales were less than in the preceding year. The accompanying table presents data from 1934 to 1938, inclusive.

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*Hydrated lime sold or used by producers in the United States, 1934–38*

| Year | Plants in operation | Short tons | Value | |
|---|---|---|---|---|
| | | | Total | Average |
| 1934 | 165 | 829,430 | $6,324,623 | $7.63 |
| 1935 | 167 | 1,005,619 | 7,939,513 | 7.90 |
| 1936 | 168 | 1,225,829 | 9,529,743 | 7.77 |
| 1937 | 170 | 1,301,333 | 10,344,470 | 7.95 |
| 1938 | 165 | 1,169,804 | 9,111,575 | 7.79 |

As the following table indicates, production of hydrated lime in 1938 was smaller than in 1937 in most States. The sharp decline of 24 percent in Missouri probably was due to a prolonged strike, which closed several large plants. Production increased in only a few States, California showing the largest proportional gain—19 percent. Ohio and Pennsylvania continued to be the leading producing States, and their combined output was 49 percent of the total for the country.

*Hydrated lime sold or used by producers in the United States, 1937–38, by States*

| State | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Alabama | 23,884 | $167,292 | 26,266 | $190,567 |
| California | 13,627 | 152,036 | 16,255 | 170,990 |
| Florida | 10,803 | 103,998 | 9,952 | 95,784 |
| Georgia | 7,881 | 61,331 | 7,046 | 54,150 |
| Illinois | 24,625 | 191,100 | 24,598 | 189,937 |
| Indiana | 31,470 | 201,970 | 32,845 | 206,290 |
| Maryland | 33,419 | 237,730 | 31,124 | 229,053 |
| Massachusetts | 35,271 | 264,247 | 34,111 | 233,748 |
| Michigan | 10,688 | 84,747 | 10,035 | 82,340 |
| Missouri | 121,321 | 769,400 | 92,090 | 602,472 |
| New York | 16,948 | 136,026 | 14,299 | 110,870 |
| Ohio | 437,925 | 3,678,118 | 391,364 | 3,247,112 |
| Pennsylvania | 212,513 | 1,751,086 | 178,180 | 1,363,343 |
| Tennessee | 41,892 | 324,207 | 44,336 | 331,734 |
| Texas | 24,415 | 226,271 | 24,264 | 235,445 |
| Virginia | 59,067 | 439,697 | 52,683 | 368,290 |
| West Virginia | 47,544 | 349,033 | 43,776 | 290,095 |
| Wisconsin | 14,257 | 111,090 | 13,814 | 112,086 |
| Undistributed [1] | 133,783 | 1,095,091 | 122,766 | 997,269 |
| | 1,301,333 | 10,344,470 | 1,169,804 | 9,111,575 |

[1] Includes Arizona, Arkansas, Colorado, Connecticut, Hawaii, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, North Carolina, Oregon, Rhode Island, South Dakota, Utah, Vermont, and Washington.

## SHIPMENTS

*Total shipments.*—Sales, shipments, and supplies of lime available for consumption by States in continental United States are given in the accompanying table. Reshipments beyond the original destinations from the producing plants are disregarded. Pennsylvania, with its great variety of industries, ranks first by a large margin in apparent consumption of both quick and hydrated lime. Other States, in order of tonnage of quicklime consumed in 1938, were Ohio, West Virginia, and Illinois, and of hydrated lime, New York, Ohio, and New Jersey. A greater tonnage of lime was shipped from Ohio than from any other State, and more lime was shipped into New York for consumption than into any other State.

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*Lime supplies available for consumption in continental United States in 1938, by States, in short tons*

| State | Sales by producers | Shipments from State | Shipments into State | Supply | | | Pounds per capita [1] |
|---|---|---|---|---|---|---|---|
| | | | | Hydrated | Quicklime | Total | |
| Alabama | 151,937 | 51,637 | 18,823 | 14,103 | 105,020 | 119,123 | 82 |
| Arizona | 39,568 | 14,475 | 832 | 1,542 | 24,383 | 25,925 | 126 |
| Arkansas | (2) | (2) | (2) | 4,665 | 9,704 | 14,369 | 14 |
| California | 71,596 | 8,776 | 23,950 | 21,844 | 64,926 | 86,770 | 28 |
| Colorado | 9,564 | 187 | 5,528 | 3,162 | 11,743 | 14,905 | 28 |
| Connecticut | (2) | (2) | (2) | 10,525 | 14,810 | 25,335 | 29 |
| Delaware | | | 31,905 | 13,269 | 18,636 | 31,905 | 244 |
| District of Columbia | | | 14,945 | 14,092 | 853 | 14,945 | 48 |
| Florida | 19,638 | | 23,764 | 23,185 | 20,217 | 43,402 | 52 |
| Georgia | 7,046 | 1,046 | 38,886 | 26,741 | 18,145 | 44,886 | 29 |
| Idaho | (2) | | (2) | 980 | 1,491 | 2,471 | 10 |
| Illinois | 135,256 | 54,976 | 131,933 | 64,999 | 147,214 | 212,213 | 54 |
| Indiana | 102,054 | 72,868 | 71,136 | 32,372 | 67,950 | 100,322 | 58 |
| Iowa | | | 40,110 | 15,092 | 25,018 | 40,110 | 31 |
| Kansas | | | 20,138 | 10,714 | 9,424 | 20,138 | 22 |
| Kentucky | (2) | | (2) | 15,045 | 34,355 | 49,400 | 34 |
| Louisiana | | | 55,085 | 11,085 | 44,000 | 55,085 | 52 |
| Maine | (2) | (2) | (2) | 9,243 | 50,022 | 59,265 | 138 |
| Maryland | 62,479 | 18,382 | 65,679 | 52,295 | 57,481 | 109,776 | 131 |
| Massachusetts | 91,453 | 69,338 | 34,850 | 25,423 | 31,542 | 56,965 | 26 |
| Michigan | 45,848 | 22,803 | 128,043 | 53,564 | 97,524 | 151,088 | 63 |
| Minnesota | (2) | (2) | (2) | 12,354 | 20,806 | 33,160 | 25 |
| Mississippi | | | 16,585 | 3,655 | 12,930 | 16,585 | 16 |
| Missouri | 298,151 | 251,075 | 25,058 | 31,733 | 40,401 | 72,134 | 36 |
| Montana | (2) | (2) | (2) | 3,482 | 6,740 | 10,222 | 38 |
| Nebraska | | | 7,771 | 6,651 | 1,120 | 7,771 | 11 |
| Nevada | (2) | (2) | (2) | 18,774 | 2,564 | 21,338 | 423 |
| New Hampshire | | | 7,389 | 2,755 | 4,634 | 7,389 | 29 |
| New Jersey | 19,940 | 5,063 | 99,442 | 84,124 | 30,195 | 114,319 | 53 |
| New Mexico | (2) | | (2) | 1,111 | 5,919 | 7,030 | 33 |
| New York | 39,439 | 5,266 | 205,633 | 127,310 | 112,496 | 239,806 | 37 |
| North Carolina | (2) | (2) | (2) | 29,596 | 17,381 | 46,977 | 27 |
| North Dakota | | | 5,317 | 5,203 | 114 | 5,317 | 15 |
| Ohio | 836,589 | 592,107 | 97,456 | 93,996 | 247,942 | 341,938 | 102 |
| Oklahoma | (2) | (2) | (2) | 7,896 | 13,787 | 21,683 | 17 |
| Oregon | (2) | (2) | (2) | 2,484 | 6,073 | 8,557 | 17 |
| Pennsylvania | 532,066 | 196,742 | 172,415 | 144,226 | 363,513 | 507,739 | 100 |
| Rhode Island | (2) | (2) | (2) | 5,802 | 3,693 | 9,495 | 28 |
| South Carolina | | | 21,345 | 12,929 | 8,416 | 21,345 | 23 |
| South Dakota | (2) | | (2) | 2,428 | 4,213 | 6,641 | 19 |
| Tennessee | 162,661 | 115,033 | 8,263 | 22,907 | 32,984 | 55,891 | 39 |
| Texas | 49,352 | 5,269 | 6,983 | 26,070 | 24,996 | 51,066 | 17 |
| Utah | 25,748 | 416 | 595 | 3,173 | 22,754 | 25,927 | 100 |
| Vermont | 58,149 | 51,692 | 662 | 1,062 | 6,057 | 7,119 | 37 |
| Virginia | 161,687 | 113,974 | 52,857 | 36,862 | 63,708 | 100,570 | 74 |
| Washington | 34,025 | 7,859 | 1,719 | 4,116 | 23,769 | 27,885 | 34 |
| West Virginia | 163,064 | 141,404 | 169,801 | 18,882 | 172,579 | 191,461 | 205 |
| Wisconsin | 55,993 | 19,515 | 48,983 | 22,504 | 62,957 | 85,461 | 58 |
| Wyoming | | | 1,681 | 872 | 809 | 1,681 | 14 |
| Undistributed | 164,060 | 68,195 | 220,078 | | | | |
| | 3,337,363 | [3] 1,888,098 | 1,875,640 | 1,156,897 | 2,168,008 | 3,324,905 | 51 |

[1] Based on latest figures of Bureau of Census.
[2] Included under "Undistributed."
[3] Includes 12,458 short tons of lime exported or unspecified by producers as to destination.

The origin and destination of hydrated, quick, and total lime shipments for 1937 and 1938, by groups of States that comprise approximate freight zones, are listed in the following tables. These data do not include a small quantity of lime (about 1 percent of the total) consisting of Hawaiian and Puerto Rican production, foreign shipments, and tonnage for which distribution is not recorded. Reshipments beyond the original destinations from the producing plants are not considered.

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*Lime shipped (supply) in continental United States, 1937–38, by origin and destination of shipments, in short tons*

| Destination | Illinois, Indiana, Michigan, Ohio | | | Maryland, New Jersey, New York, Pennsylvania, West Virginia | | | Connecticut, Maine, Massachusetts, Rhode Island, Vermont | | | Florida, Georgia, North Carolina, Virginia [1] | | | Alabama, Kentucky, Tennessee | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hydrated lime | Quicklime | Total | Hydrated lime | Quicklime | Total | Hydrated lime | Quicklime | Total | Hydrated lime | Quicklime | Total | Hydrated lime | Quicklime | Total |
| **1937** | | | | | | | | | | | | | | | |
| Illinois, Indiana, Michigan, Ohio | 241,545 | 531,735 | 773,280 | 5,102 | 49,665 | 54,767 | 173 | ---- | 173 | 815 | 4,457 | 5,272 | 1,457 | 3,236 | 4,693 |
| Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia | 153,986 | 234,981 | 388,967 | 311,039 | 646,009 | 957,048 | 28,214 | 54,693 | 82,907 | 17,082 | 87,558 | 104,940 | 2,910 | 2,662 | 5,572 |
| Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont | 19,015 | 1,011 | 20,026 | 2,593 | 30,245 | 32,838 | 41,257 | 85,215 | 126,472 | ---- | 6,266 | 6,266 | ---- | ---- | ---- |
| Florida, Georgia, North Carolina, South Carolina, Virginia | 37,730 | 3,293 | 41,023 | 9,280 | 20,017 | 29,297 | ---- | 75 | 75 | 59,693 | 46,256 | 105,949 | 27,763 | 71,728 | 99,491 |
| Alabama, Kentucky, Louisiana, Mississippi, Tennessee | 18,872 | 30,078 | 48,950 | 450 | 217 | 667 | ---- | ---- | ---- | 555 | 75 | 630 | 34,255 | 189,601 | 223,856 |
| Arkansas, Kansas, Nebraska, Oklahoma, Texas | 2,649 | 573 | 3,222 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 7 | 7 | 16 | 812 | 828 |
| Iowa, Minnesota, Missouri, Wisconsin | 29,008 | 42,916 | 71,924 | 5 | 31 | 36 | ---- | ---- | ---- | ---- | 31 | 31 | ---- | ---- | ---- |
| Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming | 1,816 | 2,255 | 4,071 | 1 | 2 | 3 | ---- | ---- | ---- | ---- | ---- | ---- | 130 | 220 | 350 |
| **1938** | | | | | | | | | | | | | | | |
| Illinois, Indiana, Michigan, Ohio | 212,455 | 419,094 | 631,549 | 3,644 | 30,713 | 34,357 | ---- | ---- | ---- | 1,373 | 6,728 | 8,101 | 1,192 | 15,171 | 16,363 |
| Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia | 138,193 | 164,958 | 303,151 | 272,945 | 450,336 | 723,281 | 22,914 | 43,449 | 66,363 | 13,244 | 66,851 | 80,095 | 2,416 | 12,743 | 15,159 |
| Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont | 17,316 | 621 | 17,937 | 1,471 | 25,919 | 27,390 | 35,767 | 82,090 | 117,857 | 256 | 1,752 | 2,008 | ---- | ---- | ---- |
| Florida, Georgia, North Carolina, South Carolina, Virginia | 36,941 | 2,356 | 39,297 | 7,811 | 20,731 | 28,542 | ---- | 44 | 44 | 54,465 | 44,559 | 99,024 | 29,021 | 58,785 | 87,806 |
| Alabama, Kentucky, Louisiana, Mississippi, Tennessee | 20,295 | 25,903 | 46,198 | 132 | 538 | 670 | ---- | ---- | ---- | 455 | ---- | 455 | 37,133 | 156,562 | 193,695 |
| Arkansas, Kansas, Nebraska, Oklahoma, Texas | 3,057 | 2,185 | 5,242 | 20 | ---- | 20 | ---- | ---- | ---- | ---- | ---- | ---- | 70 | 840 | 910 |
| Iowa, Minnesota, Missouri, Wisconsin | 28,271 | 42,146 | 70,417 | 25 | 138 | 163 | 11 | ---- | 11 | 5 | ---- | 5 | 786 | ---- | 786 |
| Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming | 1,961 | 2,148 | 4,109 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 130 | 110 | 240 |

[1] Includes South Carolina in 1937.

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*Lime shipped (supply) in continental United States, 1937–38, by origin and destination of shipments, in short tons*—Continued

| Destination | Arkansas and Texas [1] | | | Minnesota, Missouri, Wisconsin | | | Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington | | | United States | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hydrated lime | Quicklime | Total | Hydrated lime | Quicklime | Total | Hydrated lime | Quicklime | Total | Hydrated lime | Quicklime | Total |
| **1937** | | | | | | | | | | | | |
| Illinois, Indiana, Michigan, Ohio | | | | 33,356 | 150,034 | 183,390 | | | | 282,448 | 739,127 | 1,021,575 |
| Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia | | 2 | 2 | 7,626 | 28,922 | 36,548 | | | | 520,857 | 1,055,127 | 1,575,984 |
| Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont | | | | 74 | 197 | 271 | | | | 62,939 | 122,934 | 185,873 |
| Florida, Georgia, North Carolina, South Carolina, Virginia | | | | 1,902 | 3,355 | 5,257 | | | | 136,368 | 144,724 | 281,092 |
| Alabama, Kentucky, Louisiana, Mississippi, Tennessee | 4,187 | 15,625 | 19,812 | 4,687 | 19,895 | 24,582 | | | | 63,006 | 255,491 | 318,497 |
| Arkansas, Kansas, Nebraska, Oklahoma, Texas | 30,165 | 34,255 | 64,420 | 20,471 | 18,433 | 38,904 | | 100 | 100 | 53,301 | 54,180 | 107,481 |
| Iowa, Minnesota, Missouri, Wisconsin | 382 | 330 | 712 | 63,343 | 142,013 | 205,356 | | | | 92,738 | 185,321 | 278,059 |
| Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming | 783 | 740 | 1,523 | 13,640 | 7,508 | 21,148 | 62,272 | 243,259 | 305,531 | 78,642 | 253,984 | 332,626 |
| **1938** | | | | | | | | | | | | |
| Illinois, Indiana, Michigan, Ohio | 115 | | 115 | 26,152 | 88,924 | 115,076 | | | | 244,931 | 560,630 | 805,561 |
| Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia | 26 | 50 | 76 | 4,856 | 28,429 | 33,285 | | | | 454,594 | 766,816 | 1,221,410 |
| Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont | | | | | 376 | 376 | | | | 54,810 | 110,758 | 165,568 |
| Florida, Georgia, North Carolina, South Carolina, Virginia | | | | 1,075 | 1,392 | 2,467 | | | | 129,313 | 127,867 | 257,180 |
| Alabama, Kentucky, Louisiana, Mississippi, Tennessee | 5,020 | 18,182 | 23,202 | 3,364 | 17,041 | 20,405 | | | | 66,399 | 218,226 | 284,625 |
| Arkansas, Kansas, Nebraska, Oklahoma, Texas | 35,244 | 38,781 | 74,025 | 17,605 | 17,225 | 34,830 | | | | 55,996 | 59,031 | 115,027 |
| Iowa, Minnesota, Missouri, Wisconsin | 754 | 281 | 1,035 | 51,831 | 106,617 | 158,448 | | | | 81,683 | 149,182 | 230,865 |
| Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming | 252 | 184 | 436 | 10,447 | 6,936 | 17,383 | 56,381 | 166,120 | 222,501 | 69,171 | 175,498 | 244,669 |

[1] Includes Oklahoma in 1938.

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The following table shows the relatively small quantities of lime shipped from continental United States to various island Territories.

*Lime shipped to noncontiguous Territories of the United States, 1937–38*

| Territory | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| American Samoa | | | (1) | $7 |
| Hawaii | 666 | $11,212 | 1,770 | 26,071 |
| Puerto Rico | 1,024 | 13,638 | 895 | 9,643 |
| Virgin Islands | 188 | 3,947 | 97 | 1,902 |
| Wake Island | (1) | 3 | | |
| | 1,878 | 28,800 | 2,762 | 37,623 |

[1] Less than 1 ton.

*Hydrated lime.*—The following table shows total shipments of hydrated lime into various groups of States in 1937 and 1938. The largest apparent consumption is in the Middle Atlantic States, with their densely populated industrial centers. Distribution of hydrated lime from Ohio plants to the same groups of States are shown separately in the table.

*Shipments of hydrated lime from plants in continental United States and in Ohio, 1937–38, by destinations*

| Destination | From all plants | | From Ohio plants | | |
|---|---|---|---|---|---|
| | Short tons | Distribution (percent) | Short tons | Distribution (percent) | District total (percent) |
| 1937 | | | | | |
| Illinois, Indiana, Michigan, Ohio | 282,448 | 21.8 | 191,331 | 43.7 | 67.7 |
| Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia | 520,857 | 40.3 | 153,320 | 35.0 | 29.4 |
| Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont | 62,939 | 4.9 | 19,015 | 4.3 | 30.2 |
| Florida, Georgia, North Carolina, South Carolina, Virginia | 136,368 | 10.5 | 37,709 | 8.6 | 27.7 |
| Alabama, Kentucky, Louisiana, Mississippi, Tennessee | 63,006 | 4.9 | 15,872 | 3.6 | 25.2 |
| Arkansas, Kansas, Nebraska, Oklahoma, Texas | 53,301 | 4.1 | 2,528 | .6 | 4.7 |
| Iowa, Minnesota, Missouri, Wisconsin | 92,738 | 7.2 | 16,923 | 3.9 | 18.2 |
| Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming | 78,642 | 6.1 | 1,140 | .3 | 1.4 |
| Undistributed and exports | 2,791 | .2 | 87 | (1) | 3.1 |
| | 1,293,090 | 100.0 | 437,925 | 100.0 | 33.9 |
| 1938 | | | | | |
| Illinois, Indiana, Michigan, Ohio | 244,931 | 21.1 | 162,261 | 41.5 | 66.2 |
| Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia | 454,594 | 39.1 | 137,298 | 35.1 | 30.2 |
| Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont | 54,810 | 4.7 | 17,200 | 4.4 | 31.4 |
| Florida, Georgia, North Carolina, South Carolina, Virginia | 129,313 | 11.1 | 36,881 | 9.4 | 28.5 |
| Alabama, Kentucky, Louisiana, Mississippi, Tennessee | 66,399 | 5.7 | 16,530 | 4.2 | 24.9 |
| Arkansas, Kansas, Nebraska, Oklahoma, Texas | 55,996 | 4.8 | 3,041 | .8 | 5.4 |
| Iowa, Minnesota, Missouri, Wisconsin | 81,683 | 7.0 | 16,769 | 4.3 | 20.5 |
| Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming | 69,171 | 6.0 | 1,247 | .3 | 1.8 |
| Undistributed and exports | 6,295 | .5 | 137 | (1) | 2.2 |
| | 1,163,192 | 100.0 | 391,364 | 100.0 | 33.6 |

[1] Less than 0.1 percent.

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## CONSUMPTION BY USES

The quantity and value of lime (quick and hydrated) utilized in the principal consuming industries are given in the following table. Chemical lime (including metallurgical) constitutes slightly more than half of the total tonnage sold or used.

*Lime sold or used by producers in the United States, 1937–38, by uses*

| Use | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | | Value | | Quantity | | Value | |
| | Percent of total | Short tons | Total | Average | Percent of total | Short tons | Total | Average |
| Agricultural | 9.8 | 406,462 | $2,738,433 | $6.74 | 10.9 | 364,312 | $2,376,108 | $6.52 |
| Building | 23.0 | 948,553 | 8,212,995 | 8.66 | 25.5 | 854,461 | 7,163,165 | 8.38 |
| Chemical: | | | | | | | | |
| Glassworks | 4.1 | 167,438 | 1,153,845 | 6.89 | 3.8 | 126,840 | 859,937 | 6.78 |
| Metallurgy | 16.8 | 694,814 | 4,199,960 | 6.04 | 14.7 | 493,522 | 3,073,625 | 6.23 |
| Paper mills | 10.9 | 447,728 | 2,892,552 | 6.46 | 12.0 | 402,021 | 2,562,317 | 6.37 |
| Sugar refineries | .5 | 21,211 | 179,975 | 8.48 | .7 | 22,506 | 185,280 | 8.23 |
| Tanneries | 1.5 | 61,544 | 439,849 | 7.15 | 1.8 | 59,853 | 411,374 | 6.87 |
| Water purification | 5.1 | 212,213 | 1,395,728 | 6.58 | 5.6 | 186,211 | 1,273,491 | 6.84 |
| Other uses [1] | 13.3 | 546,496 | 3,659,998 | 6.70 | 14.0 | 470,602 | 3,136,986 | 6.67 |
| Total chemical (excluding dead-burned dolomite) | 52.2 | 2,151,444 | 13,921,907 | 6.47 | 52.6 | 1,761,555 | 11,503,010 | 6.53 |
| Refractory lime (dead-burned dolomite) | 15.0 | 617,706 | 5,217,833 | 8.45 | 11.0 | 366,626 | 3,095,355 | 8.44 |
| | 100.0 | [2] 4,124,165 | [2] 30,091,168 | 7.30 | 100.0 | [2] 3,346,954 | [2] 24,137,638 | 7.21 |
| Hydrated lime (included in above totals) | 31.6 | 1,301,333 | 10,344,470 | 7.95 | 35.0 | 1,169,804 | 9,111,575 | 7.79 |

[1] Details of distribution shown in a following table.
[2] Includes lime used by producers (captive tonnage) as follows—1937: 270,192 short tons, valued at $1,388,052; 1938: 168,245 tons, $985,003.

*Agricultural lime and other liming materials.*—In recent years sales of lime for agricultural uses have followed closely fluctuations in cash farm income. Scientific appraisal of the advantages of all types of fertilizers and soil conditioners should encourage a wider use of lime. The accompanying table presents data on several liming agents and their effective lime content.

*Agricultural lime and other liming materials sold or used by producers in the United States, 1937–38, by kinds*

| Kind | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | | Value | | Short tons | | Value | |
| | Gross | Effective lime content [1] | Total | Average | Gross | Effective lime content [1] | Total | Average |
| Lime from limestone: | | | | | | | | |
| Quicklime | 140,425 | 118,000 | $762,496 | $5.43 | 126,539 | 106,000 | $666,550 | $5.27 |
| Hydrated | 266,037 | 186,000 | 1,975,937 | 7.43 | 237,773 | 166,000 | 1,709,558 | 7.19 |
| Lime from oyster shells [2] | 13,098 | 10,700 | 89,119 | 6.80 | (3) | (3) | (3) | (3) |
| Oyster shells (crushed) [2] | 76,966 | 33,000 | 273,500 | 3.55 | (3) | (3) | (3) | (3) |
| Limestone | 5,004,930 | 2,152,000 | 6,454,695 | 1.29 | 4,367,410 | 1,878,000 | 5,637,485 | 1.29 |
| Calcareous marl | 46,650 | 20,000 | 59,775 | 1.28 | 23,572 | 10,100 | 40,270 | 1.71 |

[1] Estimated by method described in Mineral Resources of the United States, 1921, pt. II, p. 164.
[2] Bureau of Fisheries.
[3] Data not yet available.

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*Building lime.*—Consumption of building lime in 1938 compared favorably with that of other building materials, although sales were lower than in 1937.

*Chemical lime.*—The wide use of lime in the chemical industries may be inferred from a recently published table [1] that lists the relative frequency with which mineral raw materials are used in the actual manufacture (not purification, treatment, etc.) of 150 important industrial chemicals. In the table, limestone, which in many chemical processes is calcined to the oxide (quicklime) before actual consumption, has a relative use frequency of 63 and was surpassed by only five substances, water, air, coal, sulfur, and salt. The quantity and value of lime sold or used in 1937 and 1938 for minor chemical applications that are designated "Other uses" in a previous table were as follows:

*Chemical lime sold or used by producers in the United States for "Other uses," 1937-38*

| Use | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Acid neutralization | 3,437 | $32,819 | 5,075 | $45,080 |
| Alkali works (ammonia, soda, potash) | 13,756 | 69,809 | 12,369 | 68,556 |
| Bleach (liquid and powder) | 9,141 | 57,775 | 16,844 | 112,245 |
| Calcium carbide | 109,755 | 565,309 | 116,173 | 615,682 |
| Chromate and bichromate | 11,216 | 66,238 | 13,824 | 84,538 |
| Coke and gas manufacture (gas purification and plant byproducts) | 21,989 | 143,656 | 14,844 | 96,599 |
| Food products | 10,664 | 63,744 | 6,199 | 36,860 |
| Gelatin (edible) | 4,988 | 41,743 | 5,925 | 43,280 |
| Glue | 7,882 | 57,482 | 6,456 | 43,241 |
| Insecticides (spraying materials) | 45,967 | 358,271 | 43,921 | 350,054 |
| Magnesia works | 10,091 | 65,908 | 18,830 | 135,311 |
| Oil and fat manufacture | 20,271 | 133,116 | 13,792 | 93,313 |
| Oil refining | 10,161 | 92,873 | 6,914 | 74,772 |
| Paint (calcimine, whitewash, varnish, etc.) | 27,240 | 176,447 | 12,589 | 90,866 |
| Polishing and buffing | 3,549 | 78,563 | 2,307 | 58,508 |
| Rubber | 1,732 | 13,742 | 1,330 | 9,399 |
| Salt refining | 5,369 | 28,774 | 4,317 | 24,973 |
| Sand-lime brick | 20,746 | 140,817 | 14,417 | 94,350 |
| Sanitation | 3,977 | 25,719 | 8,693 | 58,482 |
| Silica brick and slag brick | 12,887 | 96,154 | 5,733 | 42,132 |
| Soap | 7,362 | 36,060 | 6,162 | 32,611 |
| Wood distillation | 6,029 | 43,126 | 1,012 | 7,385 |
| Miscellaneous uses [1] | 31,363 | 208,453 | 20,044 | 139,738 |
| Use unspecified | 146,924 | 1,063,400 | 112,832 | 779,011 |
| | 546,496 | 3,659,998 | 470,602 | 3,136,986 |

[1] Includes lime used in the manufacture of acetic acid, alcohol, bituminous road materials, beer, calcium acetate, calcium arsenate, calcium carbonate, calcium chloride, calcium phosphate, chemicals (not specified), corn products, dairy products, depilatories, dyes, flour, helium gas, ice, indigo, iron oxide, lubricants, nicotine, oxalic acid, oxygen, retarder, sulfur, sulfuric acid, and textiles.

The consumption of dead-burned dolomite declined greatly in 1938. Sales represented only 11 percent of the total lime business in 1938 contrasted with 15 percent in 1937.

Distribution of lime sales by States and uses in 1938 are shown in the accompanying table.

[1] Keller, R. N., and Quirke, T. T., Mineral Resources of the Chemical Industries: Econ. Geol., vol. 34, No. 3, May 1939, pp. 287-296.

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*Lime sold or used by producers in the United States in 1938, by States and uses*

| State | Building | | Agricultural | | Chemical | | | | | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Glassworks | | Paper mills | | Water purification | | Tanneries | | Metallurgy | | Other chemical (including dead-burned dolomite) | | | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 46,595 | $308,504 | (1) | (1) | | | 47,082 | $261,577 | (1) | (1) | | | 46,804 | $262,845 | 9,750 | $66,347 | 151,937 | $911,033 |
| Arizona | (1) | (1) | | | | | (1) | (1) | | | | | (1) | (1) | (1) | (1) | 39,568 | 353,224 |
| Arkansas | (1) | (1) | | | | | (1) | (1) | (1) | (1) | | | (1) | (1) | (1) | (1) | (1) | (1) |
| California | 22,912 | 254,967 | (1) | (1) | | | 2,504 | 22,594 | 2,580 | $27,116 | (1) | (1) | 18,947 | 179,812 | 23,277 | 218,605 | 71,596 | 712,388 |
| Colorado | 3,937 | 40,389 | | | | | | | (1) | (1) | | | (1) | (1) | (1) | (1) | 9,564 | 95,207 |
| Connecticut | (1) | (1) | (1) | (1) | | | | | | | | | | | (1) | (1) | (1) | (1) |
| Florida | 5,127 | 51,399 | (1) | (1) | | | | | 9,793 | 90,937 | | | | | (1) | (1) | 19,638 | 185,286 |
| Georgia | 6,058 | 50,786 | 988 | $3,364 | | | | | | | | | | | | | 7,046 | 54,150 |
| Hawaii | (1) | (1) | (1) | (1) | | | | | | | | | | | (1) | (1) | (1) | (1) |
| Idaho | (1) | (1) | | | | | | | | | | | (1) | (1) | | | (1) | (1) |
| Illinois | 20,743 | 165,617 | (1) | (1) | | | 10,284 | 56,538 | 22,759 | 159,075 | (1) | (1) | 48,854 | 336,568 | 23,112 | 178,020 | 135,256 | 965,836 |
| Indiana | 7,369 | 44,842 | 1,931 | 12,921 | (1) | (1) | 15,692 | 84,335 | 17,539 | 102,104 | 2,551 | $16,655 | (1) | (1) | 48,118 | 271,494 | 102,054 | 581,922 |
| Kentucky | (1) | (1) | (1) | (1) | | | | | (1) | (1) | | | | | (1) | (1) | (1) | (1) |
| Maine | (1) | (1) | (1) | (1) | | | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Maryland | (1) | (1) | 52,644 | 354,311 | | | (1) | (1) | | | | | | | | | 62,479 | 446,013 |
| Massachusetts | 52,017 | 463,404 | 6,827 | 50,297 | | | 4,643 | 36,897 | | | (1) | (1) | (1) | (1) | 12,659 | 89,559 | 91,453 | 741,975 |
| Michigan | 3,319 | 29,910 | (1) | (1) | | | 25,844 | 196,775 | 2,727 | 21,398 | (1) | (1) | 7,279 | 41,784 | 5,027 | 41,609 | 45,848 | 339,324 |
| Minnesota | (1) | (1) | (1) | (1) | | | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Missouri | 41,119 | 285,489 | (1) | (1) | (1) | (1) | 47,539 | 253,452 | 51,582 | 311,873 | (1) | (1) | 36,815 | 191,379 | 118,411 | 667,024 | 298,151 | 1,724,140 |
| Montana | (1) | (1) | (1) | (1) | | | | | | | | | (1) | (1) | (1) | (1) | (1) | (1) |
| Nevada | (1) | (1) | (1) | (1) | | | | | (1) | (1) | | | (1) | (1) | (1) | (1) | (1) | (1) |
| New Jersey | (1) | (1) | (1) | (1) | | | | | | | | | | | (1) | (1) | 19,940 | 145,076 |
| New Mexico | (1) | (1) | | | | | | | | | | | | | | | (1) | (1) |
| New York | 2,784 | 21,096 | 6,995 | 53,731 | | | 3,409 | 30,863 | (1) | (1) | 858 | 7,001 | (1) | (1) | 7,469 | 56,451 | 39,439 | 302,360 |
| North Carolina | (1) | (1) | (1) | (1) | | | | | | | | | | | | | (1) | (1) |
| Ohio | 351,293 | 2,966,475 | 32,092 | 213,978 | 119,739 | $816,242 | 25,500 | 148,311 | 10,935 | 64,963 | | | 30,863 | 178,032 | 266,167 | 2,270,852 | 836,589 | 6,658,853 |
| Oklahoma | (1) | (1) | (1) | (1) | | | | | (1) | (1) | | | | | | | (1) | (1) |
| Oregon | (1) | (1) | (1) | (1) | | | | | | | | | (1) | (1) | | | (1) | (1) |
| Pennsylvania | 61,068 | 507,807 | 169,799 | 1,124,287 | | | 37,734 | 253,728 | 13,828 | 101,847 | 21,594 | 152,969 | 106,872 | 684,972 | 121,171 | 958,852 | 532,066 | 3,784,462 |
| Puerto Rico | | | | | | | | | | | | | | | 2,953 | 23,554 | 2,953 | 23,554 |
| Rhode Island | (1) | (1) | (1) | (1) | | | | | | | | | | | (1) | (1) | (1) | (1) |
| South Dakota | (1) | (1) | (1) | (1) | | | | | | | | | (1) | (1) | | | (1) | (1) |
| Tennessee | 38,245 | 276,376 | (1) | (1) | | | 66,804 | 331,812 | 13,436 | 78,875 | (1) | (1) | 20,811 | 80,622 | 20,722 | 117,673 | 162,661 | 901,460 |
| Texas | 23,097 | 212,666 | (1) | (1) | (1) | (1) | (1) | (1) | 10,860 | 79,048 | | | 487 | 3,237 | 9,817 | 100,638 | 49,352 | 429,664 |
| Utah | 3,598 | 41,118 | | | | | | | 163 | 2,279 | | | 21,767 | 137,689 | 220 | 3,304 | 25,748 | 184,390 |
| Vermont | 13,168 | 104,583 | 8,031 | 41,946 | | | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | 23,512 | 170,625 | 58,149 | 415,846 |
| Virginia | 30,369 | 223,521 | 30,233 | 175,674 | (1) | (1) | 7,380 | 45,001 | 6,819 | 50,561 | (1) | (1) | 22,676 | 121,736 | 61,376 | 380,751 | 161,687 | 1,014,607 |

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| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Washington | 7,803 | 85,454 | (1) | (1) | 405 | 3,500 | | 20,757 | 17,387 | 176,578 | (1) | (1) | | 6,252 | | 4,905 | 49,283 | | (1) | (1) | | 34,025 | 348,332 |
| West Virginia | 20,636 | 135,856 | 22,277 | 113, | 974 | (1) | | (1) | 12,110 | 70,905 | 1,725 | 11,400 | | 37,010 | | 27,297 | 139,207 | | 69,267 | 470,019 | | 163,064 | 1,008,559 |
| Wisconsin | 25,981 | 226,077 | 2,388 | 13, | 220 | 3,601 | | 22,938 | 15,583 | 120,939 | (1) | (1) | | (1) | | (1) | (1) | | 10,046 | 105,953 | | 55,993 | 483,111 |
| Undistributed | 67,223 | 666,829 | 30,110 | 213, | 108 | 126,840 | | 859,937 | 402,021 | 2,562,317 | 186,211 | 1,273,491 | | 59,853 | | 411,374 | 493,622 | | 3,073,625 | [3] 859,734 | | [4] 6,417,621 | 3,346,954 | 24,137,638 |
| | 854,461 | 7,163,165 | 364,312 | 2,376, | 108 | | | | | | | | | | | | | | | | | | | |

[1] Included under "Undistributed."
[2] Includes 366,626 tons of dead-burned dolomite valued at $3,095,355.

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*Hydrated lime.*—Consumption of hydrated lime in 1938, as shown in the following table, was below that in 1937 for all major uses except sugar refineries and tanneries, which increased slightly.

*Hydrated lime sold or used by producers in the United States, 1937–38, by uses*

| Use | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Agricultural | 266,037 | $1,975,937 | 237,773 | $1,709,558 |
| Building | 670,658 | 5,674,748 | 598,981 | 4,947,957 |
| Chemical: | | | | |
| Glassworks | 2,408 | 22,768 | 867 | 5,949 |
| Metallurgy | 36,483 | 246,936 | 35,296 | 249,652 |
| Paper mills | 32,995 | 246,062 | 21,790 | 161,371 |
| Sugar refineries | 12,240 | 109,006 | 14,379 | 121,515 |
| Tanneries | 23,045 | 172,527 | 26,075 | 182,762 |
| Water purification | 111,167 | 792,408 | 94,972 | 694,103 |
| Other uses | 146,300 | 1,104,078 | 139,671 | 1,038,708 |
| Total chemical | 364,638 | 2,693,785 | 333,050 | 2,454,060 |
| | 1,301,333 | 10,344,470 | 1,169,804 | 9,111,575 |

## SIZE OF PLANTS

The following table presents data on the number of companies and plants grouped according to the quantity of lime produced in selected years. Total production of the various groups is also shown. Noteworthy features are the increase in the number of active plants producing between 25,000 and 49,999 short tons from 26 in 1928 to 35 in 1938, also the increase in the proportion of the total output made by plants producing 10,000 to 49,999 tons annually.

*Lime (including dead-burned dolomite) sold or used by producers in the United States, 1928, 1933, and 1938, by companies and plants grouped according to size*

| Size group (short tons per year) | 1928 | | | 1933 | | | 1938 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Companies | Plants | Short tons | Companies | Plants | Short tons | Companies | Plants | Short tons |
| Less than 1,000 | 152 | 152 | 37,556 | 143 | 143 | 39,374 | 98 | 98 | 27,931 |
| 1,000 to 4,999 | 74 | 74 | 186,218 | 70 | 70 | 169,760 | 77 | 79 | 179,875 |
| 5,000 to 9,999 | 44 | 46 | 320,443 | 31 | 32 | 217,706 | 30 | 32 | 213,831 |
| 10,000 to 24,999 | 47 | 51 | 741,887 | 30 | 39 | 512,397 | 40 | 42 | 633,847 |
| 25,000 to 49,999 | 19 | 26 | 681,538 | 17 | 25 | 560,600 | 27 | 35 | 963,041 |
| 50,000 to 99,999 | 17 | 34 | 1,141,000 | 7 | 15 | 548,721 | 6 | 12 | 456,525 |
| 100,000 and over | 10 | 28 | 1,349,770 | 2 | 8 | 220,722 | 6 | 23 | 871,904 |
| | 363 | 411 | 4,458,412 | 300 | 332 | 2,269,280 | 284 | 321 | 3,346,954 |

## TRENDS IN PRINCIPAL USES

Sales of chemical lime (including metallurgical) and dead-burned dolomite comprised 64 percent of the total sales of lime in 1938 compared with 67 percent in 1937. This decline, which was caused chiefly by the large decrease in sales of dead-burned dolomite, modifies the trend lines materially, as shown in figure 1. Conditions in 1938 indicated the formation of trends similar to those of the early 1920's when sales of building lime formed approximately half of the total lime sales compared with about one-fourth of the total in recent years. However, as the drastic decrease in sales of metallurgical lime and

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dead-burned dolomite in 1938 resulted from the low rate of operation in the steel industry, the pronounced change in the relative magnitude

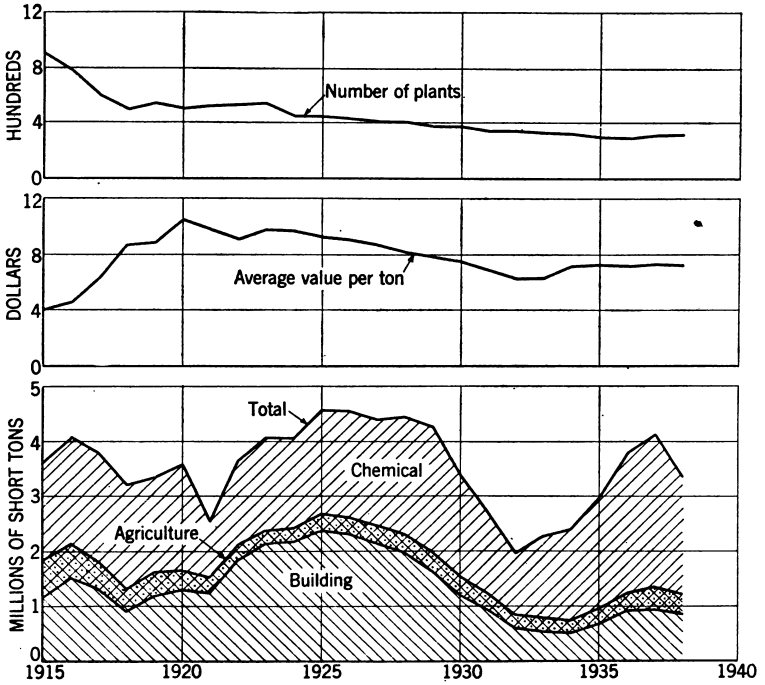


FIGURE 1.—Trends in the number of active plants, average value per ton, and principal uses of lime, 1915–38.

of sales of chemical and building lime in 1938 compared with recent preceding years is believed to be temporary only and not significant in the long-time trend.

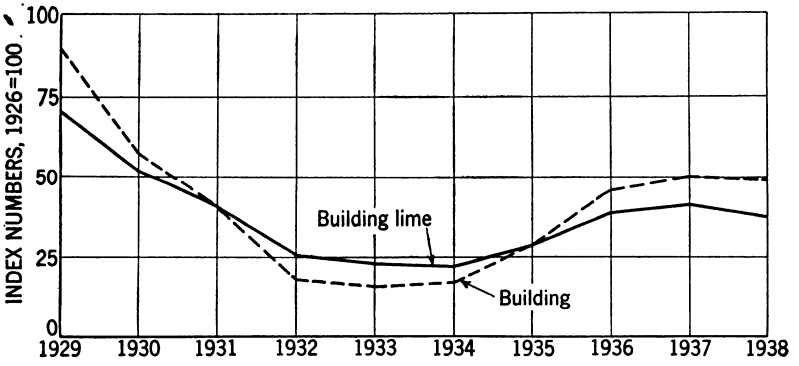


FIGURE 2.—Building-lime (quick and hydrated) sales compared with total floor area of residential and nonresidential building, 1929–38. Index numbers on building computed from F. W. Dodge Corporation data.

Figure 2 shows graphically the total quantity of lime consumed in building construction compared with the floor area of residential and nonresidential building during the 10-year period, 1929–38.

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Metallurgical lime is used chiefly for open-hearth flux in the steel industry, but minor quantities are consumed in the flotation of metallic ores, cyanidation of gold ores, smelting, and wire drawing. The relatively large use of metallurgical lime compared with steel-ingot production since 1933, as shown in figure 3, was due to an increase in the quantity of lime used in flotation and cyanidation. The disproportional rise in sales of dead-burned dolomite since 1932 compared with steel-ingot production resulted from the increasing substitution of this low-priced refractory material for higher-priced refractories in the steel industry.

## NEW DEVELOPMENTS

*Specifications.*—A tentative specification (C141–38T) for hydraulic hydrated lime for structural uses has been issued by the American Society for Testing Materials. Two types, high-calcium (containing

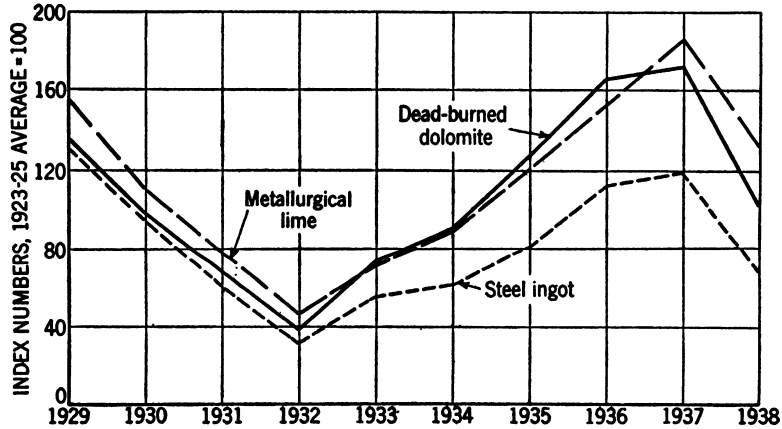


FIGURE 3.—Metallurgical lime and dead-burned dolomite sales compared with steel-ingot production, 1929–38. Index numbers on steel ingots computed by Federal Reserve Board from data of American Iron and Steel Institute.

not more than 5 percent MgO) and magnesium (containing more than 5 percent MgO) hydraulic hydrated limes, are covered.

The Federal Specifications Executive Committee has also issued a specification (SS–L–361) that covers the requirements for hydraulic hydrated lime purchased by Federal agencies.[2]

The National Lime Association after lengthy investigations has issued specifications covering lime and lime-cement mortars for use in unit masonry. These mortars contain more lime than the present-day masonry mortars and are said to afford a better bond with the building units and more weather-resistant construction.

*Plants.*—Only a few entirely new lime plants, all of relatively small capacity, were constructed during the year. Existing equipment was improved or replaced at numerous plants in all sections of the country. Capacity was increased at several plants by the addition of new kilns. Several companies substituted pulverized coal for producer gas as fuel for rotary kilns. The replacement is said to yield

[2] Copies of Federal specifications may be obtained upon application accompanied by money order, coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington, D. C. American Society for Testing Materials specifications may be obtained from the office of the secretary of the society, 260 South Broad Street, Philadelphia, Pa.

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better heat control with more efficient calcination and a reduction in costs. The reported [3] successful use of pulverized coal as fuel for shaft kilns is of interest to operators. This fuel replaced natural gas and has been used for the past several years in three kilns, of which two operated on lump limestone and one on spalls down to 1-inch size. Although the performance of the kilns varies, the average results show increased capacity and efficiency.

The successful operation [4] of a plant to manufacture carbon dioxide gas, liquid and solid (dry ice), from kiln gases of an existing lime plant was an outstanding development of the year. Capacity is reported as 15 tons of dry ice per day, which is obtained by processing the gases from one of three shaft kilns, each of which has a daily capacity of 15 tons of lime.

In 1938 a record enrollment of 35 lime plants participated in the safety contest [5] sponsored by the National Lime Association and the Bureau of Mines. The combined accident-frequency and accident-severity rates of the enrolled plants increased over 1937 and were respectively 25.2 per million man-hours of exposure and 4.3 days of disability per thousand man-hours in 1938.

*Research.*—Results of investigations by Conley [6] on the rate of calcination of cylinders of limestone, dolomite, and magnesite show that calcination proceeds at a fairly uniform rate, which is directly proportional to the exposed surface and the temperature.

## FOREIGN TRADE [7]

*Imports.*—Imports of lime, most of which is brought into Washington and California, were lower in 1938 than in 1937. The quantity and value of imports of dead-burned dolomite decreased considerably from 1937. The following tables present data on lime and dead-burned dolomite imported for consumption.

*Lime imported for consumption in the United States, 1934–38*

| Year | Hydrated lime [1] | | Other lime [1] | | Dead-burned dolomite [2] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 923 | $8,872 | 8,309 | $74,447 | 6,473 | $166,912 | 15,705 | $250,231 |
| 1935 | 1,030 | 10,571 | 3,413 | 36,032 | 7,519 | 189,714 | 11,962 | 236,317 |
| 1936 | 1,345 | 12,212 | 7,859 | 74,946 | 13,928 | 349,678 | 23,132 | 436,836 |
| 1937 | 1,174 | 13,885 | 7,614 | 76,720 | 9,083 | 231,084 | 17,871 | 321,689 |
| 1938 | 858 | 10,001 | 5,960 | 56,202 | 2,875 | 67,340 | 9,693 | 133,543 |

[1] Includes weight of immediate container.
[2] Classification changed in 1936 to "Dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime."

[3] Nordberg, Bror, Firing Shaft Lime Kilns with Unit Coal Mills: Rock Products, vol. 42, No. 3, March 1939, pp. 41–42.
[4] Rock Products, Dry Ice from Lime Kiln Gases: Vol. 41, No. 7, July 1938, pp. 31–33.
[5] Bureau of Mines, The National Lime Association Safety Contest of 1938, Health and Safety Statistics Series 261.
[6] Conley, J. E., Calcination Conditions for Limestone, Dolomite, and Magnesite: Am. Inst. Min. and Met. Eng. Tech. Paper 1037, 1939, 15 pp.
[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Lime imported for consumption in the United States, 1937–38, by countries and customs districts* [1]

| Country | Customs district | 1937 | | 1938 | |
|---|---|---|---|---|---|
| | | Short tons | Value | Short tons | Value |
| Belgium | San Antonio | | | 6 | $53 |
| Canada | Chicago | | | 1 | 13 |
| | Los Angeles | 647 | $6,447 | | |
| | Maine and New Hampshire | 143 | 1,125 | 51 | 280 |
| | New York | 17 | 218 | | |
| | St. Lawrence | 1 | 18 | | |
| | San Francisco | 3,458 | 34,238 | 2,052 | 19,392 |
| | Vermont | 5 | 58 | | |
| | Washington | 4,405 | 45,035 | 4,618 | 43,914 |
| Germany | New York | 14 | 2,013 | 16 | 1,543 |
| Japan | Pittsburgh | [2] | 132 | [2] | 65 |
| Mexico | Washington | | | [2] | 10 |
| Sweden | San Antonio | 40 | 205 | 44 | 108 |
| Switzerland | New York | | | 7 | 173 |
| United Kingdom | do | [2] | 48 | [2] | 23 |
| West Indies, British | do | 57 | 1,057 | 23 | 629 |
| | Virgin Islands | 1 | 11 | | |
| | | [3] 8,788 | 90,605 | [3] 6,818 | 66,203 |

[1] Exclusive of dead-burned basic refractory material.
[2] Less than 1 ton.
[3] Includes weight of immediate container.

*Exports.*—Exports of lime in 1938 increased in quantity but decreased in total value compared with 1937. The average value per ton (c. i. f. shipping port) was only $9.20 in 1938 against $10.88 in 1937. Details are shown in the following tables:

*Lime exported from the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 3,752 | $60,167 | 1937 | 11,300 | $122,895 |
| 1935 | 3,927 | 63,672 | 1938 | 13,222 | 121,662 |
| 1936 | 4,601 | 71,109 | | | |

*Lime exported from the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Argentina | 94 | $2,452 | 41 | $1,481 |
| Canada | 5,760 | 41,715 | 6,940 | 37,255 |
| Colombia | 2 | 54 | 250 | 5,615 |
| Cuba | 196 | 1,936 | 389 | 4,612 |
| Ecuador | 53 | 2,701 | 63 | 1,641 |
| France | 22 | 724 | 27 | 881 |
| Guatemala | 315 | 2,943 | 800 | 6,516 |
| Haiti | | | 67 | 832 |
| Honduras | 1,754 | 14,242 | 2 | 45 |
| Japan | 476 | 12,931 | 171 | 4,599 |
| Mexico | 443 | 4,787 | 2,457 | 21,516 |
| Newfoundland and Labrador | 58 | 586 | | |
| New Zealand | 53 | 694 | 65 | 846 |
| Nicaragua | 421 | 9,250 | 417 | 5,124 |
| Panama | 122 | 2,463 | 155 | 2,728 |
| Peru | 654 | 8,621 | 602 | 10,077 |
| Philippine Islands | 1 | 27 | 51 | 1,993 |
| Salvador | 63 | 761 | 45 | 607 |
| Sweden | 72 | 2,672 | 82 | [3,550 |
| Union of South Africa | 25 | 254 | 58 | 700 |
| U. S. S. R. | 30 | 1,150 | | |
| United Kingdom | 45 | 502 | 101 | 3,510 |
| West Indies: | | | | |
| British | 476 | 8,630 | 310 | 5,617 |
| Netherland | 78 | 1,191 | 93 | 1,131 |
| Other countries [1] | 87 | 1,609 | 36 | 786 |
| | 11,300 | 122,895 | 13,222 | 121,662 |

[1] Includes entries of 25 tons and under.

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# CLAYS: KAOLIN (CHINA CLAY AND PAPER CLAY), BALL CLAY, FIRE CLAY, BENTONITE, FULLER'S EARTH (BLEACHING CLAYS), AND MISCELLANEOUS CLAY

By PAUL M. TYLER and R. W. METCALF [1]

## SUMMARY OUTLINE


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| Salient statistics | 1208 | Heavy-clay products | 1219 |
| China clay or kaolin | 1208 | Prices | 1219 |
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| Fuller's earth | 1215 | | |


In 1938, notwithstanding further displacement of foreign by domestic clays, the quantity of china clay sold or used by producers in the United States dropped 19 percent, ball clay 22 percent, and fire clay 48 percent from the 1937 levels, representing the results of recession in the consuming industries. A decline of 24 percent in the output of bleaching clay (fuller's earth), however, is attributed largely to the increasing use of substitutes. Bentonite sales were about the same as during the preceding year, reduced requirement in some consuming lines being offset by increased use in others. The heavy-clay-products industries—raw material for which is used chiefly at the locality where it is obtained and hence is not included in Bureau of Mines production figures—fell off slightly. Although building-contract awards in 1938 were substantially greater than those reported for 1937, the improvement was confined to the last few months, and deliveries of many kinds of building materials, including brick and tile, did not share the upturn until after the close of the year.

Under the Anglo-American Trade Agreement, the duty on kaolin or china clay was reduced, effective January 1, 1939, from $2.50 to $1.75 per long ton, the duty on fuller's earth was cut from $1.50 to $1 per ton, and that on "wrought or manufactured" fuller's earth was dropped from $3.25 to $2 per ton. Other reductions under this agreement included the duties on brick (reduced from 25 percent to 15 percent) and on floor, wall, and quarry tiles (various rates). The second trade agreement between the United States and Canada, also effective January 1, 1939, resulted in reductions on fire brick (now 12½ percent) on common brick and other kinds of undecorated brick (now $1 per 1,000); it also halved the duties on bentonite.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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*Salient statistics of the clay industry of the United States, 1930–34 (average) and 1935–38*

| | 1930-34 (average) | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Domestic clay sold by producers: | | | | | |
| Kaolin, china clay.....short tons.. | 431,932 | 523,656 | 638,939 | 732,282 | 595,054 |
| Ball clay.....do.... | 70,299 | 96,260 | 101,324 | 121,470 | 94,968 |
| Fire clay (including stoneware clay) short tons.. | 1,487,364 | 1,938,391 | 2,471,575 | 2,785,344 | 1,458,941 |
| Bentonite.....do.... | 84,762 | 157,445 | 177,807 | 194,768 | 192,183 |
| Fuller's earth.....do.... | 259,354 | 227,745 | 230,814 | 226,165 | 170,852 |
| Miscellaneous clays.....do.... | 305,973 | 207,718 | 392,783 | 403,522 | 389,715 |
| Total domestic: | | | | | |
| Quantity.....do.... | 2,639,684 | 3,151,215 | 4,013,242 | 4,463,551 | 2,901,713 |
| Value..... | $10,977,776 | $13,054,152 | $15,688,434 | $18,004,158 | $13,483,441 |
| Imports: | | | | | |
| Kaolin or china clay.....short tons.. | 140,888 | 125,963 | 139,797 | 146,523 | 84,180 |
| Common blue and Gross-Almerode short tons.. | 11,306 | 15,552 | 32,166 | 38,549 | 20,404 |
| Fuller's earth.....do.... | 4,708 | 2,935 | 2,733 | 2,286 | 1,507 |
| Other clay.....do.... | 24,713 | 31,941 | 21,183 | 17,946 | 6,968 |
| Total imports: | | | | | |
| Quantity.....do.... | 181,615 | 176,391 | 195,879 | 205,304 | 113,059 |
| Value..... | $1,595,101 | $1,672,814 | $1,896,642 | $1,950,043 | $1,127,462 |
| Exports: | | | | | |
| Fire clay.....short tons.. | 39,709 | 49,949 | 65,874 | 77,330 | 55,764 |
| Other clay [1].....do.... | 68,978 | 101,524 | 90,569 | 91,480 | 76,383 |
| Total exports: | | | | | |
| Quantity.....do.... | 108,687 | 151,473 | 156,443 | 168,810 | 132,147 |
| Value..... | $1,323,744 | $1,865,069 | $1,844,038 | $1,948,425 | $1,565,567 |

[1] Includes fuller's earth.

## CHINA CLAY OR KAOLIN

Sales of domestic kaolin or china clay dropped in 1938 to 595,054 short tons valued at $4,740,880—substantially below the 1937 record of 732,282 tons worth $5,349,636, but almost equaling the 1936 total and well above that of any other preceding year. Imports, on the other hand, were far less in 1938 than in any previous year since 1897, amounting to only 84,180 short tons valued at $753,858 (43 percent less in quantity than in 1937). The change in the duty on china clay, effective January 1, 1939, was not announced early enough in the year to encourage postponing purchases to take advantage of the reduction, but consumers of English clays had overbought in 1937. The potters especially had to curtail operations more than did many of the consumers of American clays, which have not yet succeeded in obtaining wide adoption in plants making hotel china and certain kinds of sanitary ware and electrical porcelain.

The heaviest declines in domestic production in 1938 were in Georgia and South Carolina, which supply most of the paper and rubber clays. Output in California virtually matched the 1937 record; and even in Pennsylvania, which has a more diversified market, the decrease was moderate.

The average price of domestic sales in 1938 was $7.97 a short ton, or substantially higher than the average of $7.31 for the preceding year. Some producers accepted lower prices for their paper filler clays, and possibly for their rubber clays, but these reductions were more than offset by the higher averages reported by several producers who have notably improved the quality of their products. The main

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reason for the increase in the average, however, was the relatively great reduction in shipments of low-priced refractory kaolins from Georgia compared with those of the more expensive kinds.

Quotations throughout 1938 generally remained about where they were at the end of 1937. Paper filler clays, produced principally in Georgia, ranged in price mostly from $6 to $8 a ton, f. o. b. mines, whereas coating clays ran from this range upward to $20 or more a ton. The average prices, as reported by producers, were approximately $8 and $12 for filler and coating clays, respectively, in 1938 compared with $7.08 and $10.74 in 1937. Rubber clays in 1938 ranged from $7.50 to $11 a ton, and the average price rose above $9.75, f. o. b. Georgia or South Carolina shipping points, compared with $8.80 in 1937—again denoting an increased proportion of highly processed clays. Notwithstanding the fact that North Carolina potting clays are so much better prepared now than ever before, they are still quotable around $15 a ton f. o. b. mines.

Price schedules for English clays were virtually unchanged in 1938. However, charter rates for cargo shipments from Cornish ports, after rising to 19s. or more in 1937, ranged throughout most of 1938 at 15s. to 15s. 6d. a long ton and ocean rates on German clays fell from $4.75 to $4.50 and later to $3.75 a metric ton.

*Kaolin sold by producers in the United States, 1936–38, by States*

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | (1) | (1) | | | | |
| California | 5,772 | $53,053 | 6,674 | $62,959 | 7,057 | $50,771 |
| Delaware | (1) | (1) | (1) | (1) | (1) | (1) |
| Florida | (1) | (1) | (1) | (1) | (1) | (1) |
| Georgia | 419,395 | 2,895,878 | 503,732 | 3,546,059 | 412,632 | 3,314,918 |
| Maryland | (1) | (1) | (1) | (1) | (1) | (1) |
| Missouri | (1) | (1) | (1) | (1) | | |
| North Carolina | 8,657 | 126,353 | (1) | (1) | (1) | (1) |
| Pennsylvania | 42,370 | 138,962 | 45,916 | 152,996 | 44,312 | 146,289 |
| South Carolina | 128,199 | 965,183 | 129,120 | 1,053,805 | 98,924 | 865,177 |
| Utah | | | (1) | (1) | (1) | (1) |
| Virginia | (1) | (1) | (1) | (1) | (1) | (1) |
| Washington | | | | | (1) | (1) |
| Undistributed [2] | 34,546 | 358,309 | 46,840 | 533,817 | 32,129 | 363,725 |
| | 638,939 | 4,537,738 | 732,282 | 5,349,636 | 595,054 | 4,740,880 |

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

*Georgia kaolin sold by producers, 1934–38, by uses*

| Year | China clay, paper clay, etc. | | | Refractory uses | | | Total kaolin | | |
|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | | Short tons | Value | |
| | | Total | Average per ton | | Total | Average per ton | | Total | Average per ton |
| 1934 | 236,606 | $1,535,046 | $6.49 | 47,950 | $86,177 | $1.80 | 284,556 | $1,621,223 | $5.70 |
| 1935 | 298,275 | 2,251,785 | 7.55 | 41,383 | 95,192 | 2.30 | 339,658 | 2,346,977 | 6.91 |
| 1936 | 367,463 | 2,764,065 | 7.52 | 51,932 | 131,813 | 2.54 | 419,395 | 2,895,878 | 6.90 |
| 1937 | 423,065 | 3,332,851 | 7.88 | 80,667 | 213,208 | 2.64 | 503,732 | 3,546,059 | 7.04 |
| 1938 | 367,612 | 3,199,169 | 8.70 | 45,020 | 115,749 | 2.57 | 412,632 | 3,314,918 | 8.03 |

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## BALL CLAY

Shipments of ball clay from domestic mines totaled 94,968 short tons valued at $739,691 in 1938 compared with 121,470 tons and $890,705 during the preceding year. The 1937 figures, however, were an all-time record, and the 1938 shipments were well above the averages for earlier years when general business was much more active. Separate statistics showing imports of ball clays are not available, but tonnage receipts under the general classification of "common blue and ball clay," which ordinarily consists principally of English ball clays, were 46 percent less than in 1937. American ball clays, which are produced almost wholly in Kentucky and Tennessee, are about $4 a ton cheaper than English clays of similar quality and are being accepted by American potters and other consumers, many of whom have come around to the opinion that they are as good or better than the foreign clays that at one time were universally preferred.

Eighty percent of the shipments of domestic ball clay in 1938 were used in the manufacture of white pottery or cream-color ware, 17 percent in high-grade tile, and the remaining 3 percent in a variety of products, including architectural terra cotta, linoleum, paints, refractory brick, enamels, and miscellaneous articles.

*Ball clay sold by producers in the United States, 1936–38*

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| California | | | | | (1) | (1) |
| Illinois | (1) | (1) | (1) | (1) | (1) | (1) |
| Kentucky | 56,006 | $388,235 | 58,118 | $441,316 | 45,494 | $362,094 |
| Maryland | (1) | (1) | (1) | (1) | (1) | (1) |
| Missouri | (1) | (1) | (1) | (1) | (1) | (1) |
| New Jersey | 10,135 | 51,277 | 9,061 | 52,142 | 3,496 | 23,202 |
| Tennessee | 27,504 | 209,357 | 49,196 | 362,179 | 40,207 | 295,587 |
| Undistributed [2] | 7,679 | 47,046 | 5,095 | 35,068 | 5,771 | 58,808 |
| | 101,324 | 695,915 | 121,470 | 890,705 | 94,968 | 739,691 |

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

## FIRE CLAY

Owing to inactivity in the refractories industries and listless demand from metallurgical plants, shipments of fire clay from domestic mines were less in 1938 than in any previous year since 1934. The total shipments of fire clay and stoneware clay were 1,458,941 short tons valued at $4,060,160 in 1938 compared with 2,785,344 tons worth $7,180,938 in 1937, 48 percent less in quantity and 43 percent less in value.

Gross-Almerode glass-pot clay is a German clay that formerly was used extensively in this country in the manufacture of pots and tanks in which glass was melted; clays of this type burn dense at a relatively low temperature and are relatively free from impurities that would color glass. In 1938 the imports of these glass-pot clays aggregated only 205 short tons valued at $2,470 compared with 1,737 tons and $21,645 in 1937 and 2,145 tons and $26,852 in 1936, the first year for

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which separate statistics are available. In earlier years, however, they were much larger.

A well-known British observer has reported [2] that glass-pot makers in the United States are divided in opinion as to whether the best pots are made from 100 percent American clay or from mixtures of European and American clays. The pots themselves have been displaced to a large degree by tank furnaces, and for tank-furnace linings sillimanite and electrically cast products have tended to displace fire-clay blocks.

Imports of miscellaneous clays, including Klingenberg and certain other German fire clays as well as smaller amounts of clay of various kinds from other countries, decreased to 5,683 tons valued at $83,384 in 1938 compared with 15,558 tons valued at $203,383 in 1937 and 18,034 tons valued at $281,592 in 1936. In this group are included such specialized importations as pipe clays, pencil clays, emery wheel clays, enamel clays (other than kaolin and ball clay), etc. The total imports of fire clay, although not reported separately, probably have averaged in recent years only about one-third as much as the exports.

Exports of fire clay in 1938 were 55,764 tons worth $389,042 as against 77,330 tons worth $529,661 during the preceding year. Canada always has been the principal foreign market for American fire clay, taking about 80 percent of the total exports.

Workable deposits of fire clay are distributed widely throughout the United States, but over 75 percent of all domestic sales have been produced in Pennsylvania, Missouri, Ohio, California, Kentucky, Illinois, and New Jersey. Plastic fire clay and a smaller amount of the hard type, known as flint clay, occur in the coal measures of the Middle West and are particularly abundant in Pennsylvania, Ohio, Maryland, and Kentucky. Plastic clays, laid down before the Carboniferous and unassociated with coal, are mined in New Jersey. Refractory clays of Tertiary and other later geologic ages are worked in Texas, Mississippi, California, Washington, and Colorado. Diaspore and so-called burley clays (high-alumina) are mined only in the north central Ozark region of Missouri.

Anticipating refractory clay requirements of metallurgical industries that may be attracted by cheap electrical power from Bonneville Dam, the Oregon State Department of Geology and Mineral Industries in cooperation with the University of Washington and the Bureau of Mines, United States Department of the Interior, conducted an investigation indicating that, contrary to former opinion, western Oregon has large deposits of good fire clay and can supply the future requirements of electrometallurgical and other industries in the Pacific Northwest.[3]

For several years the Bureau of Mines has deemed it advisable to include stoneware clays in the same classification with fire clay. Stoneware clays, which are characteristically somewhat less refractory than fire clay and have a long vitrification range, are produced principally in Ohio and Illinois and are used not only for stoneware but also for yellow ware, artware, sanitary ware, and architectural terra cotta. They have the properties of a kaolin and a ball clay

[2] Turner, W. E. S., The American Glass Industry: Chem. Age (London) vol. 40, No. 1027, March 1938, p. 160.

[3] Wilson, Hewitt, and Treasher, R. C., Refractory Clays of Western Oregon: Oregon Dept. of Geol. and Mineral Industries. Bull. 6, 1938, 93 pp. (typescript).

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combined but usually contain an excess of silica and a little iron. A portion of the iron appears as specks in the fired ware; this is not objectionable for ordinary stoneware but makes the clay unsuitable for whiteware. Proper beneficiation, however, may make it possible to eliminate the iron so that the material may be used for dinnerware.

The average price of domestic fire clay and stoneware clay f. o. b. mines in 1938 was $2.78 a ton, compared with an average of only $2.48 a ton as recently as 1936. These averages show a definite rising trend. About 1900 this composite value was generally around $1 a ton, by 1914 it had risen to $1.50, and after exceeding $3 during the post-war boom (but later declining to $2.50 a ton) it seems once more to be rising to $3. Part of this increase may be attributed to more preparation, yielding a better product, but it is likely that mining costs have advanced, increased mechanization being offset by exhaustion of the more easily worked deposits.

The principal use of fire clay is for making fire-clay brick, and large quantities of ground fire clay also are used in fire-clay mortars for laying firebrick and for various refractory purposes in foundries and steel works. The leading outlets outside refractories are pottery and stoneware, saggers and wads for firing pottery, and architectural terra cotta. The production of fire-clay brick in the United States had begun to decline slightly even before 1929, when the output was 938 million brick, valued at $36,169,000. This compares with a top value of $53,416,000 in 1920 and a volume peak of 1,304 million with a value of $42,502,000 in 1917. In 1932 volume dropped to 217 million, worth $7,611,000. Following a recovery to 711 million, valued at $33,730,843 in 1937, the output undoubtedly declined sharply in 1938. Sales of refractory products normally are the first to feel the effects of a business recession and among the last to pick up again during recovery.

*Fire clay, including stoneware clay, sold by producers in the United States, 1936–38, by States*

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Alabama | 66,352 | $85,827 | 66,714 | $94,054 | 22,871 | $38,885 |
| California | 167,295 | 326,366 | 206,674 | 433,405 | 146,296 | 338,072 |
| Colorado | 54,433 | 78,567 | 59,828 | 93,587 | 48,702 | 65,678 |
| Illinois | 124,806 | 271,006 | 156,674 | 306,891 | 89,743 | 203,582 |
| Indiana | 36,572 | 63,166 | 31,345 | 58,612 | 13,852 | 30,172 |
| Kentucky | 181,345 | 470,020 | 282,003 | 750,505 | 102,836 | 304,466 |
| Maryland | 21,429 | 72,314 | 23,634 | 55,047 | 13,189 | 40,977 |
| Missouri [1] | 471,546 | 1,331,432 | 519,369 | 1,525,519 | 258,656 | 904,522 |
| New Jersey | 87,294 | 473,060 | 88,890 | 462,529 | 69,944 | 358,876 |
| New Mexico | (2) | (2) | 3,959 | 8,523 | 3,927 | 6,923 |
| Ohio | 406,896 | 860,236 | 446,999 | 988,963 | 254,719 | 566,439 |
| Pennsylvania | 733,049 | 1,741,633 | 779,745 | 2,038,524 | 338,864 | 927,370 |
| Tennessee | 19,069 | 71,846 | 18,303 | 73,166 | 12,149 | 51,448 |
| Texas | 6,394 | 57,071 | 7,576 | 82,583 | 5,113 | 33,414 |
| Utah | (2) | (2) | 9,269 | 19,256 | 12,520 | 26,103 |
| Washington | 17,137 | 51,570 | 28,787 | 46,161 | 27,082 | 51,469 |
| West Virginia | 55,767 | 99,709 | 48,619 | 94,413 | 31,658 | 68,687 |
| Other States [3] | 22,191 | 81,741 | 6,956 | 49,200 | 6,820 | 43,077 |
| | 2,471,575 | 6,135,564 | 2,785,344 | 7,180,938 | 1,458,941 | 4,060,160 |

[1] Includes diaspore and burley clay as follows—1936: 33,584 tons valued at $150,455; 1937: 49,769 tons, $245,395; 1938: 33,408 tons, $151,623.
[2] Included under "Other States."
[3] Includes States indicated by "(2)" and Arkansas, Connecticut, Idaho, Iowa, Massachusetts, Minnesota, Montana, Nebraska, New York, North Carolina, North Dakota, Oregon, South Carolina, and Virginia.

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## BENTONITE

Development of even more new uses for bentonite nearly balanced a drop in consumption in certain other industries, with the result that the output in 1938 was 192,183 short tons valued at $1,373,182, compared with 194,768 tons worth $1,500,758 in 1937. No longer than a dozen years ago, the output of this extraordinary material was almost negligible.

Small quantities of bentonite have been imported from Canada for a decade or more, but since 1930 (when separate statistics first became available) the only imports of "unwrought" bentonite have been $49 worth imported from Germany in 1932 and 1 ton valued at $5 from Italy in 1938. Imports of "wrought" bentonite likewise have been insignificant since 1930, comprising only $70 worth in 1936 (chiefly German), 1 ton valued at $30 from Canada in 1937, and 6 tons valued at $223 from Italy in 1938. The 1938 receipts from Italy are of special interest, inasmuch as they came from the newly discovered deposits of white bentonite that is not as abundant in this country as the other types. Under the trade agreement with Canada, the duty on crude bentonite was reduced from $1.50 to $0.75 a long ton and that on "wrought or manufactured" material from $3.25 to $1.625.

Exports of bentonite are included in the statistical classification "all other clays." Type 1 ("Wyoming" type) bentonite is shipped from the United States all over the world, and an examination of the high unit values for exports under this classification from the Los Angeles customs district suggests that activated earths, made by processing Type 2 (nonswelling) bentonite, likewise may be included in this same classification.

Possibly the most interesting development in the industry during 1938 was the reported discovery by Dr. Ernst A. Hauser, Massachusetts Institute of Technology chemistry professor, that bentonite films may be processed to afford a successful substitute for mica in various important uses. This new product, which is expected to come on the market in at least a small way during 1939, has been called Alsifilm, emphasizing its hydrous-aluminum-silicate composition. According to Dr. Hauser, possibly the first important commercial outlet may be as insulating tapes for wrapping wires and telephone cables. These films, however, are said to be fireproof, waterproof, chemically inert, unaffected by mold, unattractive to insects, transparent, flexible, and fairly tough. Consequently, their employment for a variety of uses where dielectric properties are not needed is suggested. It is claimed that they take ink readily and thus may prove useful for permanent documents; moreover, that they can be made of any desired thickness like built-up mica or sheets of paper glued together, only without needing any additional binder. Other uses proposed are to line food or beverage containers and to wrap butter, tobacco, cigarettes, and other perishable or oily products. Ordinarily flexible, or even creaseproof, the material may be modified in appearance and properties by incorporating various pigments and fillers.

In talking with a member of the Bureau of Mines staff, Doctor Hauser explained the formation of these films as due to the attachment of colloidal clay particles end to end in strings or tiny filaments that mat like organic fibers do in the manufacture of ordinary paper

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or felt. Although produced experimentally at first in an ultra-centrifuge, the films were later manufactured by various methods. At the moment extrusion of the moist jelly seems the most practical method of commercial production because it can be embodied readily in a continuous process whereby Doctor Hauser believes the material probably can be manufactured at a cost of only a few cents a pound. The hardening of the films to make them impervious to liquids is a separate treatment about which very little has been published. In addition to various types of bentonite, other sources of hydrous aluminum silicates have been utilized experimentally. The product from ordinary Wyoming bentonite is not colorless; in fact, it looks like oiled paper. By using a white bentonite, low in iron, however, the product can be made almost perfectly transparent.

Under the cooperative agreement between the Massachusetts Institute of Technology and the Research Corporation (137 Newbury Street, Boston, Mass.), the latter undertakes the patent protection and commercial development under a policy of making the discovery as widely available as possible. Profits from all the various enterprises conducted by the Research Corporation are reinvested in research.

Consumption of bentonite in foreign countries has not paced that in the United States, owing to its high price abroad. Domestic bentonite has been exported all over the world, but only in rather small quantities. Large, scattered bodies of bentonite have been reported in Germany, but German bentonite differs greatly in many physical properties from the American bentonites, because it contains calcium as the exchangeable base instead of sodium; some German clays, however, are being treated artificially to exchange the calcium for sodium.

European interest has been stimulated recently by the discovery of several new deposits. The U. S. S. R. is said to have large deposits of bentonite, and Italy has opened up what was reported to be an important group of deposits on the Island of Ponza, one of the Pontine group off the west coast between Rome and Naples. Samples of this new Italian material are of excellent quality and are of the swelling type, though differing from Wyoming bentonite in that they are virtually pure white. Trial shipments have been made to the United States, and already the Italians have used it in steel molding sands. Several important deposits have been found in the Western Provinces of Canada, and in 1938 the Canadian output jumped to 1,136 tons from 163 tons in 1937. Occurrences have been reported also in Japan, British India, France, Mexico, China, and New Zealand.

Bentonite prices have remained nominally $8 a ton in bulk and $10 in bags for the crude clay (dried and crushed), f. o. b. Wyoming mines, whereas selected air-floated material is quoted at $25 a ton at Chicago. As reported to the Bureau of Mines, crude bentonite ranges in price from $4 to $8 a ton, according to quality and locality. The milled clay generally sells in South Dakota at $7.50 to $8 a ton, f. o. b. cars, and in other parts of the country material prepared for oil-well drilling varies in price upward to $20.

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*Bentonite sold by producers in the United States, 1935–38, by States*

| State | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Arizona | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Arkansas | (1) | (1) | | | | | | |
| California | 29,496 | $176,571 | 12,294 | $144,863 | 15,561 | $204,672 | 15,703 | $166,998 |
| Mississippi | | | (1) | (1) | (1) | (1) | (1) | (1) |
| New Mexico | | | | | (1) | (1) | (1) | (1) |
| Oklahoma | 4,805 | 58,508 | (1) | (1) | (1) | (1) | (1) | (1) |
| South Dakota | 8,923 | 40,001 | (1) | (1) | (1) | (1) | 20,565 | 155,821 |
| Texas | 39,391 | 237,123 | 22,647 | 154,216 | 19,910 | 144,661 | 21,744 | 207,084 |
| Utah | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Wyoming | 34,415 | 350,846 | 55,090 | 520,852 | 67,958 | 659,111 | 58,911 | 530,834 |
| Undistributed [2] | 40,415 | 184,551 | 87,776 | 547,489 | 91,339 | 492,314 | 75,260 | 312,445 |
| | 157,445 | 1,047,600 | 177,807 | 1,367,420 | 194,768 | 1,500,758 | 192,183 | 1,373,182 |

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)".

## FULLER'S EARTH

Confirming the recent trend toward use of smaller quantities but better qualities of bleaching clays, Bureau of Mines figures for fuller's earth consumption in the United States show a 24-percent drop in 1938, when domestic production of fuller's earth or natural bleaching clays fell to 170,852 short tons valued at $1,707,869 compared with 226,165 tons worth $2,296,094 in 1937 and 230,814 tons worth $2,264,978 in 1936. Imports—which have been unimportant in recent years, averaging less than 2 percent of annual consumption during the last decade—also decreased further in 1938, while exports increased, though not importantly.

The predominant use of fuller's earth is in oil refining, and shipments of fuller's earth from domestic mines paralleled expansion of the petroleum industry for several decades, increasing steadily from an annual average of 40,000 tons before the World War to a peak of 335,644 tons in 1930. Following a temporary setback in the early years of the general business depression, petroleum refining resumed its strong uptrend, whereas the use of fuller's earth failed to increase after 1932. The failure of fuller's earth consumption to equal the greater activity in petroleum refining is due in part to a relative reduction in the output of lubricants, the branch of the refining industry that uses the largest proportion of bleaching clay. But new methods of processing that require much smaller additions of fuller's earth, and the substitution of other bleaching materials—first, activated earths and, in 1938, bauxite—are even more depressing factors.

Figure 1 compares fuller's earth consumption with the index of petroleum refining and with the production of lubricants. The declining proportion of lubricating oils in relation to gasoline consumption in automobiles is attributed to an increase in the average interval between oil changes. Formerly it was common practice to change oil every 500 miles; but now some car manufacturers recommend changes only every 2,000 or 5,000 miles, and some truck operators never change their oil.

In recent years about 10 percent of the domestic output of fuller's earth has been used in the refining of vegetable oils and animal fats, a

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general increase in the tonnage being attributable to the growth of these industries and to gradual displacement of imported by domestic earths. Formerly English earth was considered indispensable; it filtered well, with minimum retention of oil, and, more important, all available domestic clays imparted an unpleasant taste to the oil. With the opening up of new deposits, the use of domestic clays for treating edible products increased until 1938, when shipments to vegetable and animal oil refineries also decreased sharply, probably because of competition from artificially activated or acid-treated earths.

The United States is by far the largest producer of fuller's earth and normally exports as much as 5 percent of its domestic production. Whereas imports consist of relatively costly earths for use principally in refining edible oils and fats, exports comprise less expensive earths for use in mineral-oil refining. Exports of fuller's earth are not re-

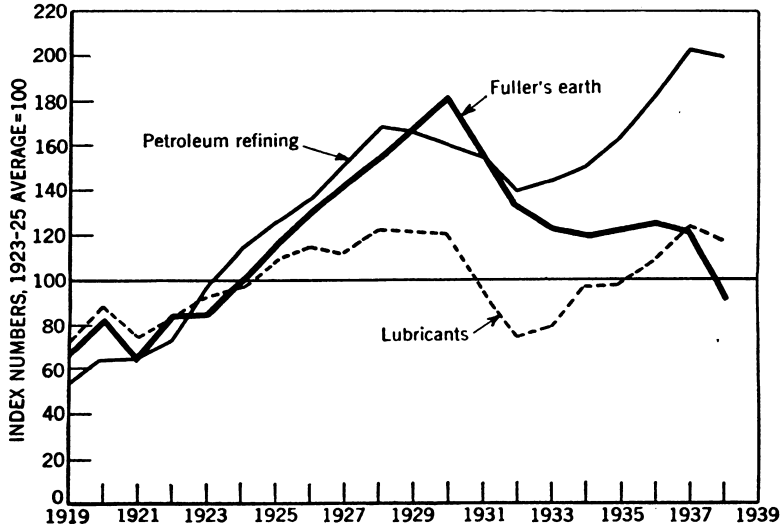


FIGURE 1.—Consumption of fuller's earth compared with petroleum refining activity (Federal Reserve Board index) and production of lubricants, 1919–38.

ported separately in the official statistics of the United States, but since 1923 domestic producers have reported their foreign shipments to the Bureau of Mines. In 1938 such shipments aggregated 10,046 short tons valued at $81,175 ($8.08 per ton) compared with 8,104 tons, worth $70,985 ($8.76 per ton) in 1937, 6,118 tons, worth $56,180 ($9.18 per ton) in 1936 and a maximum quantity of 21,264 tons in 1929, when the average value was $12.15 a ton. In 1927, when 12,287 tons were exported, the average value was $15.61.

Canada has been the most important single export market for fuller's earth in recent years, but shipments have been made to oil refineries all over the world. However, most countries having sizeable petroleum industries are able to obtain suitable bleaching earths locally, and international trade in fuller's earth is confined largely to the exports of American earth to mineral-oil refineries and of English earth to refineries treating edible oils and animal fats. Germany, which has large deposits of fuller's earth in Bavaria, produces a clay that is much less efficient than English or American earths in its natural state but is converted by hydrochloric acid treatment into an activated product

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that has a bleaching power two or three times as great. Somewhat similar activated material is made in California and Mississippi from bentonites having virtually no decolorizing power in the raw state. It is commonly claimed that the greatly improved domestic material now equals the German product in efficiency. Imports of the latter have diminished greatly, and the American activated earth is exported in substantial quantities.

Recently the United States Court of Customs and Patent Appeals upheld a decision that the German product (trade name "Tonsil") was dutiable at ¼ cent a pound and 30 percent ad valorem as "clays or earths artificially activated with acid or other material" rather than at $3.25 a ton as "fuller's earth, wrought or manufactured." The court avoided a decision on whether the product was a bentonitic clay and based its finding upon the evidence that the activity of the earth actually was increased by the acid treatment.[4]

The average value of the fuller's earth produced in the United States in 1938 was $10 a ton, f. o. b. mines, compared with $10.15 in 1937, a recent low of $9.28 in 1933, and a high of $19.51 in 1920. Prices vary according to particle size, fine material suitable only for contact use being relatively cheap. The Engineering and Mining Journal quotations for Georgia or Florida earth, f. o. b. mines, have remained unchanged for several years at $14.50 per short ton for 30- to 60-mesh, $14 per ton for 15- to 30-mesh, $10 for 200-mesh up, and $7 for 100-mesh up.

Experiments with bauxite begun in 1937, for decolorizing oils by percolation processes, were extended in 1938; at least three companies are offering it as a substitute for fuller's earth—the Porocel Corporation (260 South Broad Street, Philadelphia, Pa.), the Floridin Co. (Warren, Pa.), and Max B. Miller & Co., Inc. (50 Church Street, New York, N. Y.). It is significant that all these companies (or their affiliates) also produce fuller's earth and the Porocel Corporation is jointly interested also in the production of activated earth. The new process seems applicable only to oils of the paraffinic type and those that can be made paraffinic but is being used in at least 10 refineries in Pennsylvania and Mid-Continent oil fields. The main advantage of bauxite is that it can be revivified indefinitely, whereas fuller's earth loses its efficiency and must be discarded after 20 burnings.[5]

On the other hand, new uses for fuller's earth may be developing in water purification. According to Weir,[6] the regular use of 20 pounds of clay costing about 10 cents per million gallons, with alum applications, has increased the efficiency of water treatment in Atlanta, Ga., 10 to 30 percent. At Chester, Pa., 43 pounds of clay costing 35 cents were used successfully for treating oily trade waste waters. The clay produces a heavy floc that reduces putrescence, odors, and even coliform bacteria. The United States has some 10,000 water-treatment plants, supplying about 65 million people with 5 billion gallons of water a day, thus indicating a daily demand of 50 to 100 tons of clay or roughly 10 percent of the quantity of fuller's earth now being consumed. However, about 300 tons of activated carbon are consumed daily in removing unpleasant odors and tastes from water; and if clay could be used instead of carbon, or even as an adjunct

[4] Oil, Paint, and Drug Reporter, Feb. 13, 1939, p. 33.
[5] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, p. 3.
[6] Weir, Paul, Use of Bleaching Clays in Water Purification: Am. Inst. Min. and Met. Eng. Tech. Pub. 1018 (Min. Technol., vol. 3, No. 1, January 1939), 11 pp.

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thereto, the potential demand might be of the order of 1 million tons or more yearly (as it takes 10 to 50 times as much clay as carbon).

The adsorptive power of fuller's earth of the Georgia-Florida type (montmorillonite) itself is being increased 20 percent by an extrusion treatment. The moistened clay is pugged (kneaded) and then forced through slots, very much as common brick are formed in an auger machine. This process not only makes a better product but permits virtually complete recovery of all the clay in granular form suitable for percolation methods of oil refining, thereby enhancing its value further.

*Fuller's earth sold by producers in the United States, 1936–38, by States*

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| Florida and Georgia | 139,376 | $1,426,346 | 131,100 | $1,441,588 | 91,031 | $987,391 |
| Nevada | (1) | (1) | 4,485 | 51,718 | 5,984 | 57,499 |
| Texas | 46,855 | 462,656 | 49,500 | 473,408 | 37,998 | 358,980 |
| Other States [2] | 44,583 | 375,976 | 41,080 | 329,380 | 35,839 | 303,999 |
| | 230,814 | 2,264,978 | 226,165 | 2,296,094 | 170,852 | 1,707,869 |

[1] Included under "Other States."
[2] 1936: California, Colorado, Illinois, Indiana, Massachusetts, Nevada, and New Jersey; 1937-38: California, Colorado, Illinois, Mississippi, and Tennessee.

## MISCELLANEOUS CLAY

Clay utilized for making common brick, sewer pipe, and other clay products ordinarily is not included in Bureau of Mines statistics. It comprises probably 90 percent of all clay dug; but little of it is merchant clay, as most of it is fabricated at integrated plants situated close to the pits. The bulk of the "miscellaneous clays" reported by the Bureau of Mines, however, falls in this category, which also includes some of the clay used as a blending material for portland cement and such rotary oil-well-drilling muds as do not fall in the bentonite class. Virtually the entire miscellaneous group is composed of clays worth not more than about $1 a ton, although a few specialties, such as slip clay, are valued much higher. A large part of the California drilling mud formerly classed as bentonite is now known to be of a different character and is classified as miscellaneous clay.

*Miscellaneous clay, including slip clay [1] and shale, sold by producers in the United States, 1935–38*

| State | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| California | 57,670 | $61,144 | 149,152 | $239,277 | 153,315 | $217,938 | 135,923 | $374,166 |
| Colorado | 23,142 | 19,267 | 53,381 | 47,643 | 65,190 | 58,916 | 54,115 | 49,249 |
| Indiana | 15,657 | 11,646 | 12,980 | 10,593 | 10,024 | 6,405 | 3,089 | 1,692 |
| Iowa | | | | | (2) | (2) | 6,055 | 36,725 |
| Nebraska | | | (2) | (2) | (2) | (2) | 16,009 | 7,532 |
| Ohio | (2) | (2) | (2) | (2) | 5,259 | 12,380 | 47,226 | 28,751 |
| Pennsylvania | 21,401 | 21,767 | 43,211 | 109,228 | 50,208 | 53,481 | 39,196 | 23,136 |
| Washington | 4,950 | 4,397 | 26,831 | 52,920 | 21,071 | 45,118 | 11,901 | 10,638 |
| Other States [3] | 84,898 | 150,436 | 107,228 | 227,158 | 98,455 | 391,789 | 76,201 | 329,770 |
| | 207,718 | 268,657 | 392,783 | 686,819 | 403,522 | 786,027 | 389,715 | 861,659 |

[1] Includes slip clay as follows: 4,316 tons, valued at $25,839 in 1935 and 3,617 tons, $23,058 in 1936, from New York and Pennsylvania; 6,087 tons, $39,889 in 1937 and 2,227 tons, $13,955 in 1938 from Michigan and New York.
[2] Included under "Other States."
[3] Includes States indicated by "(2)," and Alabama, Arkansas, Connecticut, Georgia, Illinois, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nevada, New Jersey, New Mexico, New York, North Dakota, Oklahoma, Tennessee, Texas, Utah, Virginia, and Wisconsin.

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## HEAVY-CLAY PRODUCTS

In February 1938 shipments of common brick turned upward after declining steadily for 9 months, but the rise was moderate and total shipments probably were much less than in 1937. Employment in brick, tile, and terra cotta works in the United States confirmed the apparent uptrend, the 1938 pattern being almost the reverse of that of the preceding year. Stocks increased in 1937 but were much reduced in 1938, contributing further to the more optimistic viewpoint at the year end. As is shown by the usual indexes based upon 1923–25 averages, however, these industries still lag behind other building-material industries and far behind the recovery in general factory employment and production.

The Bureau of the Census reports that in 1937 the value of all clay products made in the United States, exclusive of pottery and nonclay refractories, was $159,853,658 compared with $136,249,772 in 1936. For common brick alone the value rose from $30,108,170 to $34,009,775 and the quantity from 2,967 million in 1936 to 3,253 million in 1937. In 1925, the peak year, the production of common brick was 7,562 million worth $88,551,400.

## PRICES

Available quotations for the several kinds of clays and fuller's earth have been summarized already in this chapter under the respective subheads. The average valuations of the specific groups as reported by producers are summarized in the following table:

*Average values per short ton of various kinds of clay sold by producers in the United States, 1930–34 (average) and 1935–38*

| Year | Kaolin | | Ball clay | Slip clay | Fire clay and stoneware clay | Bentonite | Fuller's earth |
|---|---|---|---|---|---|---|---|
| | United States | South Carolina | | | | | |
| 1930–34 (average) | $6.44 | $6.83 | $7.16 | $6.83 | $2.59 | $8.13 | $10.62 |
| 1935 | 7.19 | 7.57 | 6.55 | 5.99 | 2.64 | 6.65 | 9.79 |
| 1936 | 7.10 | 7.53 | 6.87 | 6.37 | 2.48 | 7.69 | 9.81 |
| 1937 | 7.31 | 8.16 | 7.33 | 6.55 | 2.58 | 7.71 | 10.15 |
| 1938 | 7.97 | 8.75 | 7.79 | 6.27 | 2.78 | 7.15 | 10.06 |

## CONSUMPTION AND USES

The real magnitude of the industries of the United States that depend on clay is not revealed by Bureau of Mines figures. Not only do they exclude the raw clay used in making common brick, hollow building blocks, and other heavy-clay products but also, even for plants where the tonnages and value of raw clay is reported, they fail to show the value of the fired clay articles that are the real products sold.

Moreover, some of the clays used locally for pottery making may not be reported at all, not even in respect to their estimated value as raw clay. In California, for example, a wide variety of fire clays and miscellaneous clays, as well as kaolin, can be grouped in the general classification of pottery clays, being used in the manufacture of red and brown earthenware; china and sanitary ware; flower pots; floor, faience, and ornamental tiling; architectural terra cotta; and similar

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products. As pointed out by State Mineralogist Bradley,[7] of California, the output of "pottery clay" in that State alone in 1936 was 382,823 tons, worth only $646,920, whereas products manufactured from this clay were worth $9,886,209.

The accompanying table, which shows sales of specified domestic clays by kinds and uses in 1937, continues a series begun in 1921. Since it does not include imported clays and since domestic clays have displaced imported clays more and more, the data for different years are not accurately indicative of consumption or even strictly comparable. This is especially true in respect to the total consumption of china clay in hotel china, sanitary ware, electrical porcelain, and coating paper, the industries in which English clays have been chiefly used. Minor displacements have occurred in other lines.

Sales of fuller's earth are shown in a separate table because the uses other than for refining oils and fats, although increasing, are relatively small.

*Clay (excluding fuller's earth) sold by producers in the United States in 1938, by kinds and uses, in short tons*

| Use | Kaolin | Ball clay | Fire clay and stoneware clay | Bentonite | Miscellaneous clay including slip clay | Total |
|---|---|---|---|---|---|---|
| Pottery and stoneware: | | | | | | |
| Whiteware, etc. | 40,052 | 75,647 | 911 | ---------- | ---------- | 116,610 |
| Chemical stoneware | ---------- | ---------- | 18,549 | ---------- | ---------- | 18,549 |
| Stoneware | ---------- | ---------- | 27,459 | ---------- | ---------- | 27,459 |
| Art pottery | 228 | 195 | 2,021 | ---------- | 19 | 2,463 |
| Flowerpots | ---------- | ---------- | 615 | ---------- | 6,650 | 7,265 |
| Slip for glazing | ---------- | ---------- | ---------- | ---------- | 574 | 574 |
| | 40,280 | 75,842 | 49,555 | ---------- | 7,243 | 172,920 |
| Tile, high-grade | 11,785 | 16,005 | 3,033 | ---------- | 257 | 31,080 |
| Kiln furniture, etc.: | | | | | | |
| Saggers, pins, stilts | 1,335 | 132 | 28,872 | ---------- | ---------- | 30,339 |
| Wads | ---------- | ---------- | 7,174 | ---------- | ---------- | 7,174 |
| | 1,335 | 132 | 36,046 | ---------- | ---------- | 37,513 |
| Architectural terra cotta | ---------- | 935 | 13,303 | ---------- | 890 | 15,128 |
| Paper: | | | | | | |
| Filler | 291,359 | ---------- | 1,621 | ---------- | ---------- | 292,980 |
| Coating | 71,020 | ---------- | ---------- | ---------- | ---------- | 71,020 |
| | 362,379 | ---------- | 1,621 | ---------- | ---------- | 364,000 |
| Rubber | 70,799 | ---------- | 4,960 | ---------- | ---------- | 75,759 |
| Linoleum and oilcloth | 4,751 | 500 | 6,611 | ---------- | 1,780 | 13,642 |
| Paints: | | | | | | |
| Filler or extender | 4,294 | 436 | 1,461 | ---------- | 353 | 6,544 |
| Kalsomine | 3,565 | ---------- | ---------- | ---------- | ---------- | 3,565 |
| | 7,859 | 436 | 1,461 | ---------- | 353 | 10,109 |
| Cement manufacture | 34,238 | ---------- | 1,666 | 676 | 30,660 | 67,240 |
| Refractories: | | | | | | |
| Firebrick and block | 35,951 | 300 | 742,382 | ---------- | ---------- | 778,633 |
| Bauxite, high-alumina brick | ---------- | ---------- | 10,848 | ---------- | ---------- | 10,848 |
| Fire-clay mortar, including clay processed for laying firebrick | 1,662 | ---------- | 143,578 | ---------- | 30 | 145,270 |
| Clay crucibles | ---------- | ---------- | 584 | ---------- | ---------- | 584 |
| Glass pots | ---------- | 58 | 523 | ---------- | ---------- | 581 |
| Other glass refractories | 94 | ---------- | 3,111 | ---------- | ---------- | 3,205 |
| Zinc retorts and condensers | ---------- | ---------- | 8,225 | ---------- | ---------- | 8,225 |
| Foundries and steel works | 3,160 | ---------- | 297,072 | 32,627 | 11,241 | 344,100 |
| | 40,867 | 358 | 1,206,323 | 32,627 | 11,271 | 1,291,446 |

[7] Bradley, W. W., California's Commercial Minerals: Mining Congress Jour., vol. 24, No. 9, September 1938, p. 18.

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*Clay (excluding fuller's earth) sold by producers in the United States in 1938, by kinds and uses, in short tons*—Continued

| Use | Kaolin | Ball clay | Fire clay and stoneware clay | Bentonite | Miscellaneous clay including slip clay | Total |
|---|---|---|---|---|---|---|
| Miscellaneous: | | | | | | |
| Rotary-drilling mud | | | | 47,093 | 114,467 | 161,560 |
| Filtering and decolorizing oils (activated earths) | | | | 90,028 | (1) | 90,028 |
| Artificial abrasives | | 2 | 611 | | 1,653 | 2,266 |
| Asbestos products | 338 | | 844 | | | 1,182 |
| Chemicals | 1,850 | | 84 | | | 1,934 |
| Enameling | | 725 | 221 | | | 946 |
| Plaster and plaster products | 3,762 | | 634 | | | 4,396 |
| Heavy clay products | 60 | 3 | 123,300 | | 188,792 | 312,155 |
| Other uses | 14,751 | 30 | 8,668 | 21,759 | [2] 32,349 | 77,557 |
| | 20,761 | 760 | 134,362 | 158,880 | 337,261 | 652,024 |
| Grand total, 1938 | 595,054 | 94,968 | 1,458,941 | 192,183 | 389,715 | 2,730,861 |
| 1937 | 732,282 | 121,470 | 2,785,344 | 194,768 | 403,522 | 4,237,386 |

[1] Included under "Other uses." [2] Includes tonnage indicated by (1) above.

*Fuller's earth sold or used by producers in the United States, 1934–38, by uses*

| Year | Bleaching, clarifying, decolorizing, or filtering— | | | | Other uses | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Mineral oils | | Vegetable oils and animal fats | | | | | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 201,902 | $1,894,140 | 16,281 | $176,611 | 2,081 | $14,330 | 220,264 | $2,085,081 |
| 1935 | 202,525 | 1,977,056 | 21,496 | 223,458 | 3,724 | 29,715 | 227,745 | 2,230,229 |
| 1936 | 202,809 | 1,977,825 | 22,489 | 238,354 | 5,516 | 48,799 | 230,814 | 2,264,978 |
| 1937 | 200,705 | 2,046,331 | 20,404 | 211,982 | 5,056 | 37,781 | 226,165 | 2,296,094 |
| 1938 | 150,062 | 1,542,459 | 12,214 | 106,187 | 8,576 | 59,223 | 170,852 | 1,707,869 |

## TECHNOLOGY

No longer content with even the best clay that nature provides, consumers are now getting processed clays whose properties not only are definitely controlled but also can be modified within wide limits. There is growing evidence to show that whiteness, opacity, and other characteristics of a good coating clay depend to an astonishing degree on fineness. Two American companies are employing Bird's solid-bowl continuous centrifuge, with or without electrophoretic attachment, to effect exact control of particle size. A coating clay made by this process contains no particles over 2 microns in size, and any desired fractionation can be accomplished with precision. Certain paper-filling clays that ordinarily would be worth $7 a ton yield, by this low-cost treatment, a fair proportion of these superquality clays worth $15 to $80 a ton, the coarser fractions still being usable as filler clays. Bleaching, too, has become a fine art that can be accomplished with scientific exactitude. Instead of merely neutralizing cream tints with bluing, the offending iron can be removed in large part from many clays by wet treatment with hydrosulfite or a combination of zinc and sulfurous acid. Other clays are gray due to carbon or organic matter removable sometimes by heating (though this may ruin the structure of a paper clay), or possibly by froth flotation. Of equal importance to paper makers are the newly developed methods for determining quickly the quality of a given coating material. Using the color analyzer built by Prof. Arthur C. Hardy of the Massachusetts Institute of Technology, reflectance of a given sample can be plotted directly over the whole spectrum in 5 minutes. Properly processed

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Georgia clays show an average reflectance of close to 90 percent of the standard magnesia button for virtually all wave lengths within the visible range. No means has yet been discovered commercially to eliminate the depression in the shorter wave-lengths due to titanium, but the sharp valley due to absorption by iron oxides can be smoothed out almost completely by suitable beneficiation.

National Bureau of Standards tests [8] on 45 experimental papers with different filling and sizing material show that for the same pulp furnish, the smoothness values were about the same for precipitated calcium carbonate and clay, and less for natural calcium carbonates, titanium dioxide pigments, and zinc sulfide pigments. With respect to their influence on the oil penetrability of the paper, the order in decreasing rapidity of penetration was: Precipitated calcium carbonate, natural calcium carbonate, zinc sulfide pigments, titanium dioxide pigments, and clay. The fillers ranked in this latter order also in respect to the degree to which they increase air permeability.

Another National Bureau of Standards report [9] relates to pressures for extruding clays and late trends in clay products manufacture have been reviewed comprehensively by Hursh.[10]

Processing of Illinois weathered glacial clay to provide good-quality oil-well drilling mud, bond clays, and bleaching clays is reported [11] as offering commercial possibilities.

Everyone knows what clay is, yet no one has been able to define it satisfactorily. Not only do most clays comprise a variety of minerals, but the same minerals do not always exhibit the same properties. Plasticity, generally cited as the chief characteristic of clays, is almost absent from some kaolins whose composition, mineralogically and chemically, corresponds exactly with what once was assumed as being "typical clay substance." On the other hand, other substances that no one would think of calling clay become plastic when suitably handled and worked. Reporting a lecture by Sir William Bragg, Searle [12] has reviewed the present knowledge of the structure of clays, with special emphasis upon new developments in X-ray examination. On this basis clays are divided into only two groups, (1) those allied to halloysite, kaolinite, nacrite, and dickite; and (2) those allied to pyrophyllite—including montmorillonite, beidellite, bentonite, and fuller's earth (which differ in metal content). In both complex silicates and clays, he says, the atoms (oriented at the apexes of tetrahedra) form a pattern of rectangular units, and the various sheets or layers must fit perfectly in combination even though they may differ slightly in separate existence. The suggested structures explain the colloidal properties of the smallest clay particles, the relatively enormous effect of minute additions of alkalis or acids to clay pastes and suspensions, and they go far to explain variations in plasticity. The "cause of plasticity," according to Sir William Bragg, is the entry of water molecules into the unit cells. The effect of this entry on the clay lattice is to increase the *c* axis without altering the *a* and *b* axes, opening it up like an accordion. This water acts as a lubricant,

[8] Shaw, M. B., and Simmons, R. H., Printing Tests of Experimental Book Papers: Nat. Bureau of Standards Jour. Research, vol. 22, No. 3, March 1939, pp. 285–294 (Research Paper 1180).

[9] Shull, R. T., and Johnson, P. V., Relation Between Moisture Content and Flow-Point Pressure of Plastic Clay: Nat. Bureau of Standards Jour. Research, vol. 22, No. 3, March 1939, pp. 329–337 (Research Paper 1186).

[10] Hursh, R. K., New Developments in the Processing and Forming of Clay Products: Illinois State Geol. Survey Circ. 33-c, 1938, pp. 19–25.

[11] Lamar, J. E., Grim, R. E., and Grogan, R. M., Gumbotil as a Potential Source of Rotary Drilling Mud, Bonding Clay, and Bleaching Clay: Illinois State Geol. Survey Circ. 39 (Mines), July 15, 1938, 23 pp.

[12] Searle, A. B., Clay: Nature, vol. 141, No. 3570, Apr. 2, 1938, p. 583.

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allows the clay particles to move easily without loss of shape or mass.

The peculiar ability of some clays to absorb water molecules and to arrange them in successive sheets in the layerlike structure of the clay crystal itself also may explain the property of "base exchange" of some derivatives of montmorillonite clays (zeolites). In spite of their complexity, the aluminosilicates can be classed in three simple groups, according to whether the structure is (1) fibrous, (2) micaceous, or (3) framework. The first (compare fibrous zeolites) has rigid molecular binding in only one direction, like rope strands that can be pulled apart easily in two directions. The second group has rigid binding in two directions but not in the third; its members split easily into thin sheets, frequently spontaneously in liquids. Mica, talc, the bentonites, pyrophyllite, and even kaolinite have been classed as micaceous minerals, and their platy cleavage results naturally from this structure. The third group has rigid binding in all directions. It does not follow, however, that the framework is always compact and impermeable; in fact it may be so open and porous that ions flow in and out, as in certain zeolites. All three types of structure are found in clays, shales, and surface soils; but in the finer grain sizes, micaceous types predominate and tend to determine the behavior of the mixture. Ross and Kerr distinguish four groups of clay minerals (1) kaolin group, (2) montmorillonite (bentonite) group, (3) potassium-bearing clays, and (4) a more evasive group occurring in shales. However, real structural data, as outlined by Sir William Bragg, appear to be available only for the first group.

A new concept for the transition of colloidal clay sols to gels has been prepared by the discoverer of Alsifilm, the mica substitute.[13]

## NEW PLANTS

New construction trends during 1938 have been summarized as follows: [14]

The Louisiana Boganite Corporation recently completed a new plant at Bogalusa, La., for the production of drilling mud and filter and bleaching clays. The equipment in this modern new plant includes a 40-ft. rotary drier, a Williams hammer-mill, a Raymond 5-roller high-side mill with a Whizzer separator, a Raymond flash-drying system, etc.

A new plant with two Gruendler hammer-mills was built by the Georgia Coating Clay Co. at Macon, Ga. Louisville driers and Raymond equipment were also installed in this plant, and in the new plants of the Sgoda Corporation at Phillips, Ga., and the Champion Paper & Fiber Co., at Sandersville, Ga. A new oil-well clay plant with a Raymond mill was built by the Beaumont Cement Sales Corporation at Villa Platte, Tex. Quality Earths, Thomasville, Ala., built a new plant. New equipment in the plant of the Filtrol Corporation, Jackson, Miss., includes a Research Corporation Cottrell precipitator, a Raymond mill, a Jeffrey hammer-mill, and other equipment. The California Kaolin Co. plans to erect a $10,000 plant at Lone Pine, Cal. The Earthen Products Co., Houston, Tex., completed a $25,000 reequipment and expansion program.

In Minerals Yearbook 1938 (p. 1122) it was recorded that the new plant of the Tennessee Bleaching Clay Corporation at Paris, Tenn., had been burned in 1937; it was rebuilt subsequently and operated in 1938.

[13] Hauser, E. A., and LeBeau, D. S., Studies of Gelatin and Film Formation of Colloidal Clays: Jour. Phys. Chem., vol. 42, No. 7, October 1938, pp. 961–969.

[14] Pit and Quarry, Gypsum, Phosphate, Feldspar, Other Groups Record Important Advances: Vol. 31, No. 7, January 1939, p. 76.



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# ABRASIVE MATERIALS

By BERTRAND L. JOHNSON and M. SCHAUBLE

## SUMMARY OUTLINE


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The abrasive materials industry followed general decline in activity that characterized 1938. The aggregate values of both natural and artificial abrasives sold in 1938 were considerably less than in 1937, although trends in the values of individual abrasives were mixed. There were marked declines in the values of diatomite, tripoli, ground sand and sandstone, grindstones and pulpstones, millstones, garnet, and emery in 1938 compared with 1937. Increased values were shown, however, for quartz, oilstones and related products, and pumice and pumicite. The value of imports of abrasives was off 36 percent from 1937 and the value of exports, 7 percent.

*Salient statistics of abrasives industries in the United States, 1937–38*

| | 1937 | 1938 | Percent of change in 1938 |
|---|---|---|---|
| Domestic production (sold or used by producers): | | | |
| Natural silica abrasives: | | | |
| Diatomite | [1] $1,459,118 | [1] $1,459,118 | ---------- |
| Tripoli | 450,570 | 329,081 | −27.0 |
| Quartz | 66,041 | 88,197 | +33.5 |
| Ground sand and sandstone | 1,996,528 | 1,425,445 | −28.6 |
| Special silica stone products: | | | |
| Grindstones and pulpstones | 572,708 | 240,006 | −58.1 |
| Oilstones and related products | 112,841 | 130,277 | +15.5 |
| Millstones | 8,305 | 3,743 | −54.9 |
| Flint lining and grinding pebbles | [2] | [2] | ---------- |
| Natural silicate abrasives: | | | |
| Pumice and pumicite | 301,936 | 312,886 | +3.6 |
| Garnet | 382,535 | 191,658 | −49.9 |
| Natural alumina abrasives: | | | |
| Emery | 2,780 | ---------- | ---------- |
| Total natural abrasives | [3] 3,894,244 | [3] 2,721,293 | −30.1 |
| Total artificial abrasives [4] | 8,364,587 | 6,238,034 | −25.4 |
| Foreign trade: | | | |
| Imports | 7,418,172 | 4,727,004 | −36.3 |
| Exports | 1,160,089 | 1,075,070 | −7.3 |

[1] Average for 1936–38, not included in totals given; Bureau of Mines not at liberty to publish annual figures.
[2] Bureau of Mines not at liberty to publish figures.
[3] Excludes value of diatomite and flint lining and grinding pebbles, which the Bureau of Mines is not at liberty to publish.
[4] Includes some material produced in Canada; Bureau of Mines not at liberty to publish United States data separately.



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This chapter includes most of the materials used principally for abrasive purposes, although those mentioned later under "Miscellaneous abrasive materials" are not included in the statistics given herein. Several commodities listed as abrasive materials for which statistical data are given also have important nonabrasive uses.

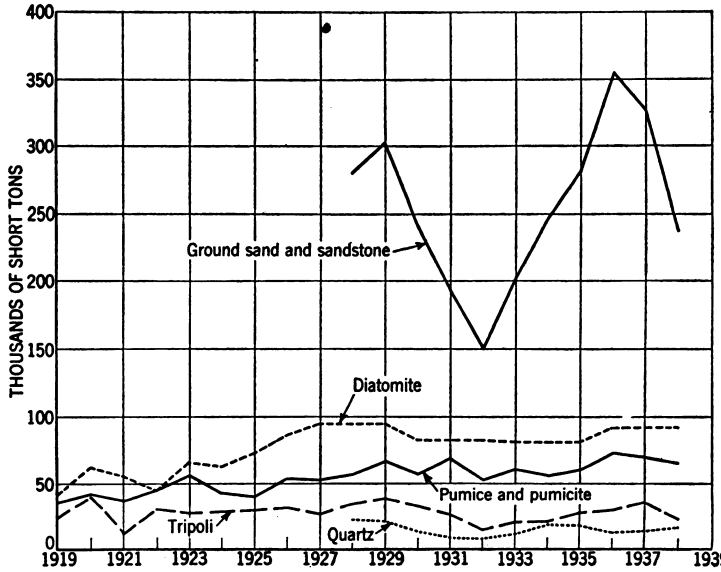


FIGURE 1.—Trends in production of diatomite, tripoli, pumice and pumicite, quartz, and ground sand and sandstone, 1919–38.

A general review of the abrasives industry in 1937 by Eardley-Wilmot [1] appeared in 1938.

## NATURAL SILICA ABRASIVES

*Diatomite.*—The Bureau of Mines has not been at liberty to publish annual production figures on diatomite since 1926. Production data for 3-year periods, however, may be shown, and the averages for the 3-year periods since 1926 are plotted in figure 1. The trend in sales of diatomite in the immediate predepression years was upward, reaching an all-time peak in 1929. Total sales for the 3-year period 1927–29 were 286,426 short tons. Sales in the next two periods declined, but in 1936–38 they recovered to 279,645 tons—not quite the predepression level. Sales in 1938 were considerably less than those in 1937, but even in 1937 they did not reach the level of the all-time peak year 1929 or of 1930.

The greater part of the domestic production of diatomite comes from the Western States. California continued in 1938 to be the chief source, but sales were reported also in other Western States (Idaho, Nevada, Oregon, and Washington), as well as in Florida and New York. The following table presents such data on diatomite sales from 1933 to 1938 as the Bureau of Mines may publish.

[1] Eardley-Wilmot, V. L.: Mineral Industry for 1937, McGraw-Hill Book Co., New York, vol. 46, 1938.

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*Diatomite sold or used by producers in the United States, 1933–38* [1]

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1933<br>1934<br>1935 | 244,342 | $3,618,428 | 1936<br>1937<br>1938 | 279,645 | $4,377,353 |

[1] Bureau of Mines not at liberty to publish annual figures.

A review of the diatomite industry during 1937 appeared early in 1938.[2] The fresh-water diatomite deposits of the Pacific Coast region were described by Mulryan [3] in a recent publication. Deposits of fresh-water diatoms occur in commercial quantities in California, Oregon, Washington, Idaho, Nevada, and Arizona. In general they are associated with volcanic activity of late Tertiary or Pleistocene time. The deposits are roughly circular, with their maximum thickness at the center. Some of the older dry deposits are horizontal; others tilt as much as 50°. Deposits also are found in present-day lakes. Ordinarily these diatomite deposits are composed essentially of types of diatoms that produce the heavier powders, their uses being limited to polishes, fillers, admixtures, and insulation products. The chief exception is the Terrebonne deposit from which filtration powders are also produced.

*Tripoli.*—Sales of tripoli (including Pennsylvania rottenstone) in 1938—the lowest since 1934—decreased more than 12,000 tons from 1937 and reversed the rising trend from the 1934 low point through 1937. Sales in 1938 were only 22,188 short tons valued at $329,081. Tripoli was produced in Arkansas, California, Illinois, Missouri, Oklahoma, and Tennessee. The Missouri-Oklahoma and Illinois districts were the principal producing areas. Rottenstone was produced only in Pennsylvania. Figure 1 shows the trend of the industry in recent years. The following table gives the data for tripoli from 1934 to 1938.

*Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1934–38*

| Year | Illinois | | Other States [1] | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 7,417 | $119,418 | 13,112 | $209,938 | 20,529 | $329,356 |
| 1935 | 10,001 | 113,484 | 17,374 | 269,932 | 27,375 | 383,416 |
| 1936 | 10,981 | 138,063 | 17,506 | 253,815 | 28,487 | 391,878 |
| 1937 | 11,647 | 151,154 | 23,289 | 299,416 | 34,936 | 450,570 |
| 1938 | 8,141 | 117,107 | 14,047 | 211,974 | 22,188 | 329,081 |

[1] 1934: Arkansas, California, Georgia, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1935: Arkansas, California, Georgia, Missouri, Oklahoma, and Pennsylvania; 1936: Arkansas, California, Missouri, Oklahoma, and Pennsylvania; 1937-38: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Tennessee.

Of the domestic tripoli sold in 1938, 36.5 percent was for abrasive uses, but in some years, such as 1936, as much as 60 percent has been so used. The second largest use has been for fillers, which took 8,363 tons in 1937 but only 5,584 tons (25 percent of the total) in 1938. The

[2] Eardley-Wilmot, V. L., Work cited in footnote 1.

[3] Mulryan, Henry, Fresh-water Diatomite in the Pacific Coast Region: Am. Inst. Min. Met. Eng. Tech. Pub. 1057, May 1939, 8 pp. (Read at Los Angeles Meeting, October 1938.)

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following table gives the quantity and value of tripoli and rottenstone sold or used by producers and classified by them according to uses.

*Tripoli sold or used by producers in the United States in 1938, by uses*

| Use | Producers reporting | Short tons | Value | Percent of total | |
|---|---|---|---|---|---|
| | | | | Quantity | Value |
| Abrasives | 8 | 8,097 | $138,807 | 36.5 | 42.2 |
| Concrete admixture | 3 | 2,170 | 12,634 | 9.8 | 3.8 |
| Filler | 4 | 5,584 | 78,900 | 25.2 | 24.0 |
| Miscellaneous [1] | 5 | 6,337 | 98,740 | 28.5 | 30.0 |
| | [2] 10 | 22,188 | 329,081 | 100.0 | 100.0 |

[1] Includes tripoli used for filter block, foundry facing, and other unspecified uses.
[2] A producer reporting more than one use is counted only once in arriving at total.

The tripoli deposits of western Tennessee and Mississippi, characteristics of the tripoli, technology, and possible uses were described in a report [4] published early in 1938.

*Quartz.*—Sales of crude, crushed, and ground quartz from pegmatite dikes, veins, and quartzite beds were decidedly greater both in quantity and value in 1938 than in 1937. The quantity sold was greater than in any year since 1929. The average value per ton, however, fell from $5.08 in 1937 to $4.74 in 1938. Figure 1 shows the trend in sales of quartz in recent years. The greatest increase in tonnage was in crushed quartz, but the greatest increase in value was in the higher-priced ground quartz. Sales of ground quartz, although higher than in 1937, recovered little of their slump since the high sales of 1934. Massachusetts, Oregon, and Wisconsin produced quartz in 1938, in addition to the States that were productive in 1937.

Data on sales of quartz by kinds from 1934 to 1938 and by States from 1936 to 1938 are shown in the following tables.

*Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1934–38*

| Year | Crude | | Crushed | | Ground | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | [2] 4,447 | [2] $16,168 | (2) | (2) | 13,846 | $113,797 | 18,293 | $129,965 |
| 1935 | [2] 7,586 | [2] 26,807 | (2) | (2) | 9,592 | 84,977 | 17,178 | 111,784 |
| 1936 | [2] 6,281 | [2] 24,971 | (2) | (2) | 6,705 | 71,621 | 12,986 | 96,592 |
| 1937 | 3,252 | 10,096 | 5,891 | $24,652 | 3,869 | 31,293 | 13,012 | 66,041 |
| 1938 | 4,493 | 17,023 | 9,930 | 27,941 | 4,188 | 43,233 | 18,611 | 88,197 |

[1] To avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] "Crushed" included under "Crude."

[4] Spain, E. L., Vestal, F. E., Davis, F. A. W., and Johnson, Martin, Tripoli Deposits of Western Tennessee and Mississippi: T.V.A., Water Control Planning Dept., Geol. Div. Geol. Bull. 8, Knoxville, Tenn., February 1938, 18 pp.

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*Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1936–38, by States*

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| California | (2) | (2) | 746 | $6,072 | 1,494 | $20,809 |
| Maine and New Hampshire | | | 96 | 243 | 243 | 663 |
| Maryland | 525 | $7,155 | 410 | 5,850 | 377 | 6,000 |
| Massachusetts | | | | | 140 | 840 |
| North Carolina | 1,005 | 11,398 | 792 | 6,261 | 763 | 9,390 |
| Virginia | | | 369 | 1,063 | | |
| Undistributed [3] | 11,456 | 78,039 | 10,599 | 46,552 | 15,594 | 50,495 |
| | 12,986 | 96,592 | 13,012 | 66,041 | 18,611 | 88,197 |

[1] To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Included under "Undistributed."
[3] 1936: Arizona, California, New Jersey, New York, Ohio, and Tennessee; 1937: Arizona, New York, Ohio, and Tennessee; 1938: Arizona, New York, Ohio, Oregon, Tennessee, and Wisconsin.

*Ground sand and sandstone.*—Both the quantity and value of sales of ground sand and sandstone declined sharply in 1938 from those in 1937. Sales totaled only 237,167 short tons valued at $1,425,445 in 1938 compared with 328,156 tons valued at $1,996,528 in 1937. The larger producing States are usually Illinois, New Jersey, Ohio, and Pennsylvania.

The following tables give the sales of ground sand and sandstone from 1934 to 1938 for the United States as a whole and in 1937 and 1938 for such States as can be shown.

*Ground sand and sandstone sold or used by producers in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 248,026 | $1,392,173 | 1937 | 328,156 | $1,996,528 |
| 1935 | 281,665 | 1,678,295 | 1938 | 237,167 | 1,425,445 |
| 1936 | 356,423 | 2,146,464 | | | |

*Ground sand and sandstone sold or used by producers in the United States, 1937–38, by States*

| State | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Illinois | 96,329 | $575,251 | 66,583 | $418,881 |
| Massachusetts | 2,613 | 12,448 | 1,234 | 4,102 |
| New Jersey | 82,398 | 430,743 | 63,968 | 338,195 |
| Ohio | 37,935 | 296,649 | 28,540 | 177,876 |
| Undistributed [1] | 108,881 | 681,437 | 76,842 | 486,391 |
| | 328,156 | 1,996,528 | 237,167 | 1,425,445 |

[1] 1937: California, Missouri, North Carolina, Pennsylvania, Virginia, West Virginia, and Wisconsin; 1938: California, Missouri, Pennsylvania, Virginia, West Virginia, and Wisconsin.

Figure 1 shows the trend in production of ground sand and sandstone.

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The quantities of ground sand and sandstone sold for different uses in 1938 and their total and average value per ton for each use are listed in the following table. Data for sales by uses from 1936 to 1938, inclusive, show that the "pottery, porcelain, and tile" industry is by far the leading market with the abrasive industry in second place in each of these 3 years. Other important uses are in foundry operations, in enamel manufacture, and as a filler.

*Ground sand and sandstone sold or used by producers in the United States in 1938, by uses*

| Use | Short tons | Value | |
|---|---|---|---|
| | | Total | Average per ton |
| Glass | 7,306 | $38,097 | $5.21 |
| Foundry | 22,413 | 134,158 | 5.99 |
| Pottery, porcelain, and tile | 93,790 | 631,592 | 6.73 |
| Enamel | 10,784 | 63,360 | 5.88 |
| Cleansing and scouring compound | 62,439 | 308,926 | 4.95 |
| Other abrasive use | 543 | 5,933 | 10.93 |
| Filler | 8,878 | 43,741 | 4.93 |
| Other | 31,014 | 199,638 | 6.44 |
| Total reported by uses | 237,167 | 1,425,445 | 6.01 |

*Abrasive sand.*—Abrasive sands are hard sands with a high percentage of silica. They include all natural sands used for abrasive purposes, such as sawing stone, grinding glass, making sandpaper, and sandblasting. Sales in recent years have followed the general industrial trend from a peak in 1929 to a low in 1932 and a recovery to 1,067,178 short tons valued at $1,440,736 in 1937. Statistics for 1938 and the relationships of abrasive sand to the rest of the sand and gravel industry are shown in the chapter on Sand and Gravel in this volume.

Schwalbe,[5] in an article in Glass Industry, describes the processing, at the River Rouge plant of the Ford Motor Co., of raw Manistee Beach sand from Lake Michigan and the continuous grading and classification of the grinding sand by grain size.

## SPECIAL SILICA STONE PRODUCTS

*Grindstones and pulpstones.*—The total value of grindstones and pulpstones sold by producers in the United States in 1938 ($240,006) was less than in any year since 1895, when only $205,768 worth was sold. The tonnage and value of grindstones sold in 1938 were lower than in any year since 1914 when they were first shown separately. The value of pulpstones sold in 1938 was less than in any year since 1932.

Natural grindstones were produced in northeastern Ohio and western West Virginia in 1938 and pulpstones in West Virginia and Washington.

[5] Schwalbe, F. G., Grading and Reclaiming Grinding Sand: Glass Ind., vol. 19, No. 6, June 1938, pp. 207–212.

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The following table gives sales of these materials from 1934 to 1938, inclusive.

*Grindstones and pulpstones sold by producers in the United States, 1934–38*

| Year | Grindstones | | Pulpstones | | |
|---|---|---|---|---|---|
| | | | Quantity | | Value |
| | Short tons | Value | Pieces | Equivalent short tons | |
| 1934 | 9,781 | $285,603 | 760 | 2,849 | $177,631 |
| 1935 | 11,476 | 342,864 | 948 | 3,111 | 162,514 |
| 1936 | 10,703 | 334,363 | 685 | 2,472 | 163,634 |
| 1937 | 11,617 | 352,377 | 761 | 2,924 | 220,331 |
| 1938 | 4,653 | 149,019 | 417 | 1,553 | 90,987 |

*Oilstones and related products.*—The demand for sharpening stones of various types was markedly less in 1938 than in 1937; consequently, sales of oilstones and related products were lower than in 1936 and 1937, but remained above those of the depression years, 1931 to 1935. Several States helped meet the demand: Arkansas furnished novaculite for oilstones and whetstones; Indiana and Ohio sandstone for oilstones, scythestones, and whetstones; New Hampshire schist for scythestones; and Indiana fine-grained sandstones for manufacture into rubbing stones.

The following table shows the sales of oilstones and related products from 1934 to 1938.

*Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 396 | $94,419 | 1937 | 810 | $112,841 |
| 1935 | 439 | 105,589 | 1938 | 511 | 130,277 |
| 1936 | 752 | 121,196 | | | |

*Millstones.*—The value of natural millstones sold in the United States in 1938 dropped to the lowest point reached in the 59 years for which the statistics of production of millstones have been recorded. This value, $3,743, was less than half that of sales in 1937. Sales in 1938 were confined to two States—New York with four producers and Virginia with two. American millstones have been made, for the most part, of quartz sandstones and conglomerates. As in recent years, production in 1938 was confined to millstones of these types—the "Esopus" stone from the Shawangunk conglomerate in Ulster County, N. Y., and the "Brush Mountain" fine-grained quartzite from Brush Mountain, Montgomery County, Va.

The following table gives the annual production data for natural millstones and related products from 1934 to 1938.

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*Value of millstones, chasers, and dragstones sold by producers in the United States, 1934–38*

| Year | New York | | Other States[1] | | Total | |
|---|---|---|---|---|---|---|
| | Producers | Value | Producers | Value | Producers | Value |
| 1934 | 5 | $3,381 | 3 | $6,720 | 8 | $10,101 |
| 1935 | 8 | 4,645 | 3 | 4,885 | 11 | 9,530 |
| 1936 | 6 | 5,458 | 3 | 5,151 | 9 | 10,609 |
| 1937 | 6 | (2) | 2 | (2) | 8 | 8,305 |
| 1938 | 4 | (2) | 2 | (2) | 6 | 3,743 |

[1] 1934–35: North Carolina and Virginia; 1936–38: Virginia.
[2] Bureau of Mines not at liberty to publish figures.

*Flint lining and grinding pebbles.*—The moderate, continuous domestic demand for noncontaminating grinding materials for use in certain mineral-processing industries requiring a product with a minimum iron content has been met in recent years partly by one or two domestic producers and partly by imports.

In 1938 sales of domestic liners, which were less than in 1937, were reported only by the Jasper Stone Co., Sioux City, Iowa, the material marketed being quartzite quarried near Jasper, Rock County, Minn. Sales of quartzite pebbles by this company also were less than in 1937. A new producer, the King Solomon Mines Co., Black Bear (near Yreka), Siskiyou County, Calif., mined and used a considerable tonnage of ball-mill pebbles in its gold mill.

Flint grinding pebbles occur in the beaches derived from flint-bearing chalk cliffs on both the English and French coasts of the English Channel and on the islands off the coast of Denmark. France and Denmark are the only flint-pebble exporting countries, as the English production is insufficient for its own needs. Flint grinding pebbles are imported into the United States from both Denmark and France.

## NATURAL SILICATE ABRASIVES

*Pumice and pumicite.*—Sales of pumice and pumicite in 1938 were lower in quantity than in 1937 but were somewhat higher in value. Figure 2 shows the trend in sales of pumice and pumicite in recent years for various uses, and the following table gives the values of the total annual sales from 1934 to 1938.

*Pumice and pumicite sold or used by producers in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 56,169 | $207,058 | 1937 | 71,007 | $301,936 |
| 1935 | 60,000 | 247,076 | 1938 | 65,742 | 312,886 |
| 1936 | 72,915 | 328,406 | | | |

Landes [6] has described the age, origin, distribution, and reserves of pumicite (volcanic ash) in the Great Plains, Cordilleran, and Pacific Coast regions of the United States and in the individual States. Volcanic ash is the finest material ejected from volcanoes. Larger, highly cellular, glassy ejecta are termed "pumice." Inasmuch as

[6] Landes, K. K., Distribution of Volcanic Ash; Bull. Am. Ceram. Soc., vol. 17, No. 8, August 1938, pp. 323–325.

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volcanoes have been active in the West during many geologic periods, deposits of volcanic ash or its alteration products are found in the rocks of many ages. Most of the volcanic ash in the Cretaceous and older rocks has been altered to bentonite. Unchanged volcanic-ash deposits, however, occur in Tertiary, Pleistocene, and Recent strata. Most of the ash marketed today comes from Pleistocene deposits and the rest from Tertiary. The Pleistocene deposits of volcanic ash of the Great Plains occur in many distinct and separate deposits in protected dune areas. Most of the Tertiary ash, however, fell in

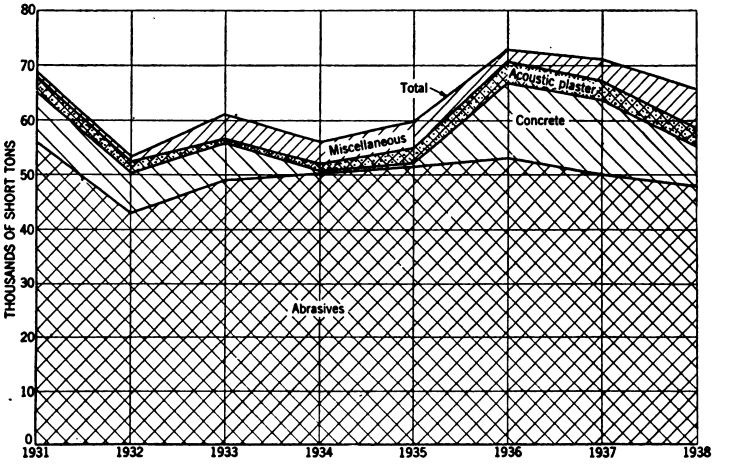


FIGURE 2.—Trend, by uses, of pumice and pumicite sold or used by producers in the United States, 1931–38.

large interior lakes, where it is interbedded with other sediments. The source volcanoes for the Pleistocene volcanic ash are thought to be members of the Capulin group in northeastern New Mexico. The Tertiary ash beds of the Great Plains area probably originated through volcanic activity in the Cordilleran area. The volcanic-ash deposits within the Cordilleran and Pacific Coast areas doubtless resulted from volcanism in those regions. Present exploitation is not making serious inroads on the immense reserves of these materials.

Pumicite (volcanic ash) was produced in 1938 in Kansas, Nebraska, and Oklahoma in the Great Plains area and in California and Oregon in the Pacific Coast region. Lump pumice was produced in the latter region only—in California and Oregon. A volcanic-tuff [7] deposit at Grants, N. Mex., was exploited in 1938 and the product ground and marketed as domestic pumice.

The quantities of pumice and pumicite sold or used in 1938 for all specified uses (except miscellaneous) declined from 1937. The greater part of the total is sold for abrasive purposes, such as cleansing and scouring compounds and hand soaps. The demand for this use has been relatively constant in recent years—roughly around 50,000 tons a year—and in 1938 the quantity sold or used was 47,013 tons. Sales for the next most important use, concrete admixture and concrete aggregate, after rising abruptly from a few hundred tons in 1935 to nearly 14,000 tons in 1936 and 1937, were curtailed to 7,596 tons in 1938. (See fig. 2.)

[7] Landes, K. K., Work cited in footnote 6.

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*Pumice and pumicite sold or used by producers in the United States, 1937–38, by uses*

| Use | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average | | Total | Average |
| Cleansing and scouring compounds and hand soaps | 48,608 | $193,559 | $3.98 | 47,013 | $188,807 | $4.02 |
| Other abrasive uses (unspecified) | 1,442 | 17,369 | 12.05 | 938 | 8,499 | 9.06 |
| Concrete admixture and concrete aggregate | 13,839 | 23,650 | 1.71 | 7,596 | 18,297 | 2.41 |
| Acoustic plaster | 3,641 | 54,459 | 14.96 | 3,080 | 54,055 | 17.55 |
| Miscellaneous uses [1] | 3,477 | 12,899 | 3.71 | 7,115 | 43,228 | 6.08 |
| | 71,007 | 301,936 | 4.25 | 65,742 | 312,886 | 4.76 |

[1] 1937: Includes material used in asphalt, grading roads, chicken litter, filtering, rock gardens and landscaping, building tiles, floor sweep, and some unspecified uses; 1938: Includes material used in asphalt, filtering, rock gardens and landscaping, building tiles, and some unspecified uses.

The volcanic-ash deposits of Oklahoma were described in 1938 in a publication of the Oklahoma Geological Survey.[8] The manufacture of pumicite-concrete building blocks at Napa, Calif., by the Basalt Rock Co. was described in an article [9] published early in 1939.

In Iceland [10] crushed pumice stone mixed with cement is being employed for hollow building blocks for residential construction.

The use of volcanic ash as a ceramic raw material has not been extensive, although its practicability has been indicated both by laboratory and industrial applications. Plummer [11] described the effect of volcanic ash in glazes by comparing such glazes with those of nearly identical composition except that they contained feldspar or equivalent materials. The volcanic ash was used successfully in several types of glazes, replacing the feldspar and part of the flint and constituting in some glazes more than 50 percent of the total weight of the raw materials. No significant difference was noted between the volcanic-ash glazes and the control glazes except that the iron oxide colored the volcanic ash. Plummer considers that the use of volcanic ash to replace feldspar in glazes and glass batches offers a distinct economic advantage because of the low cost of this material and its finely divided natural condition, which should be of especial importance in colored glazes for roofing tile, wall tile, and low-priced pottery. The slight neutralization of the colors is said to give more pleasing effects in artware and ceramic sculpture.

*Garnet.*—The general decline in industrial activity in the United States in 1938 reacted on the sales of garnet, which in 1938 were only a little over half as large as in 1937. (See fig. 3.) Sales of abrasive garnet in 1938 were reported by four companies, but only three companies, one each in New York, New Hampshire, and North Carolina, mined garnet during 1938—the Barton Mines Corporation, North Creek, Warren County, N. Y.; Davenport Garnet Co., South Danbury, Merrimack County, N. H.; and the Celo Mines, Inc., Burnsville, Yancey County, N. C. The Warren County Garnet

[8] Beach, J. O., Volcanic Ash and Tripoli: Oklahoma Geol. Survey Mineral Rept. 1, 1938, 29 pp.
[9] Rockwood, N. C., Lightweight Building Unit and Cambered Shingle: Rock Products, vol. 42, No. 2, February 1939, pp. 63–65, 69.
[10] American commercial attaché, Copenhagen, Denmark, Pumice-cement Building Blocks: Bureau of Foreign and Domestic Commerce Construction Circ. 47, July 31, 1938, p. 9.
[11] Plummer, Norman, Ceramic Uses of Volcanic Ash: Bull. Am. Ceram. Soc., vol. 18, No. 1, January 1939, pp. 8–11.

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Mills, Weaverton, Warren County, N. Y., sold garnet from stock. A little less than 2 tons of garnet were imported in 1938, the first imports of this material since 1933.

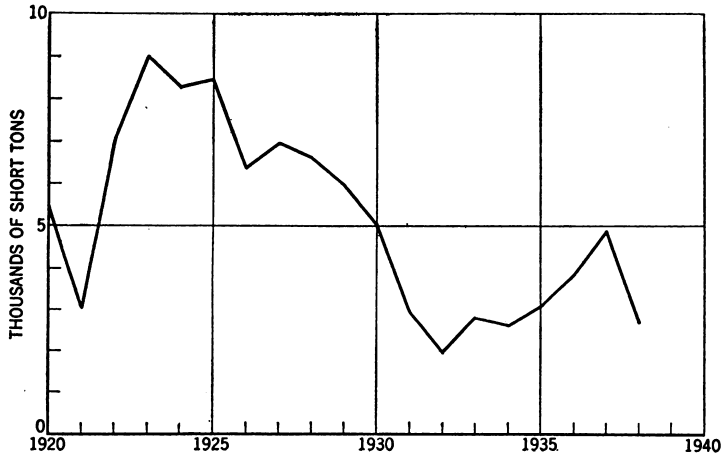


FIGURE 3.—Marketed production of abrasive garnet in the United States, 1920–38.

The following table shows the quantity and value of abrasive garnet sold or used by domestic producers since 1934.

*Abrasive garnet sold or used by producers in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 2,591 | $214,815 | 1937 | 4,863 | $382,535 |
| 1935 | 3,060 | 256,520 | 1938 | 2,669 | 191,658 |
| 1936 | 3,820 | 315,913 | | | |

During 1938 domestic demand arose for a very fine grained abrasive of the type represented by the Belgian razor honestone ("coticule"), now imported into this country for use in sharpening razor blades and the microtome knives used in the preparation of microscope-slide specimens. The Belgian "coticule" is a regionally metamorphosed, argillaceous sedimentary rock occurring in the Ardennes in southeastern Belgium as thin, clear yellow to yellowish gray, compact, homogeneous, fine-grained beds ½ to 3 inches thick, interstratified with blue-gray or violet Cambrian phyllites, in some places merging gradually into them but more often sharply distinct in coloring.

Billions of tiny, nearly spherical, polyhedral, hard crystals of light-yellow manganese garnet, spessartite, in a soft sericite matrix, form the principal element of the "coticule" and explain its yellow color, hardness, peculiar fitness for hones, and manganese content (17 to 22 percent MnO). The average diameter of these microscopic garnets is about 0.0008 inch. Tiny rutile and tourmaline crystals also occur in the "coticule." The mineral composition of the phyllite differs from that of the "coticule" in that hematite and carbonaceous matter are present.

The beds of coticule and attached phyllite are cut in a characteristic manner. As the phyllite has abrasive qualities part of it is left

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attached to the "coticule" to support it. The hones thus appear double-faced, with yellow "coticule" on one side and the softer blue-gray phyllite on the other.

Wright [12] presented the results of an extensive study to determine the varieties of garnets characteristic of different rock types. A remarkable constancy of association was shown between a given variety and a certain type of rock. His summary table of the major molecules of garnets in the rock types is reproduced here.

*Average proportion of major molecules of garnets in rock types*

| Rock type | Spessartite | Grossularite | Pyrope | Almandite | Andradite |
|---|---|---|---|---|---|
| Pegmatite | 47.1 | | | 41.8 | |
| Granite | 36.0 | | | 56.8 | |
| Garnets associated with contact action on siliceous rocks | 30.7 | | | 56.4 | |
| Biotite schists | | 6.0 | 13.8 | 73.0 | |
| Amphibole schists | | 20.7 | 20.3 | 53.6 | |
| Eclogites | | 18.5 | 37.4 | 39.1 | |
| Kimberlites and peridotites | | 9.0 | 72.3 | 13.4 | |
| Various basic rocks | | 28.7 | 20.7 | 34.4 | 15.6 |
| Calcareous contact rocks | | 51.5 | | | 40.8 |

The occurrence of garnets in Triassic conglomerate in York County, Pa., was described in 1938 by Stose and Glass.[13]

Miller [14] described the occurrence, character, and possible genesis of certain garnet deposits of the Adirondacks, including the Hooper, Barton, old Hooper, and Humphrey Mountain mines.

The occurrence of garnets in California was described by Sperisen [15] and Pabst.[16]

## NATURAL ALUMINA ABRASIVES

*Corundum.*—No corundum has been mined in the United States since 1918, and regular annual production stopped in 1906. Domestic demand for crude corundum in 1938 was met by the importation of 2,098 short tons valued at $138,629, chiefly from the Union of South Africa. Both the quantity and value of imports were slightly greater than in 1937. (See fig. 4.) Virtually all corundum and emery is imported in the crude state and crushed and graded in this country for the domestic market. Imports of both corundum ore and emery ore have been curtailed sharply in depression periods.

*Emery.*—No sales of domestic emery were made in 1938. Production in the United States in recent years has been confined to the deposit of spinel-bearing emery near Peekskill, Westchester County, N. Y. Competition of artificial abrasives and imported emery and corundum has caused a general downward trend in the demand for domestic emery since the World War. Since 1933 sales have been

[12] Wright, W. I., The Composition and Occurrence of Garnets: Am. Mineral., vol. 23, No. 7, July 1938, pp. 436–445. (Abstract of a thesis submitted in partial fulfillment for the degree of doctor of philosophy, University of Minnesota, Minneapolis, Minn.)

[13] Stose, G. W., and Glass, J. J., Garnet Crystals in Cavities in Metamorphosed Triassic Conglomerate in York County, Pennsylvania: Am. Mineral., vol. 23, No. 7, July 1938, pp. 430–435.

[14] Miller, W. J., Genesis of Certain Adirondack Garnet Deposits: Am. Mineral., vol. 23, No. 6, June 1938, pp. 399–408.

[15] Sperisen, F. J., Gem Minerals of California: California Jour. Mines and Geol., vol. 34, No. 1, January 1938, pp. 34–78. (See pp. 60–62.)

[16] Pabst, Adolf, Minerals of California: California Dept. Natural Resources, Div. Mines Bull. 113, 1938, 344 pp. (See pp. 289–297.)

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only a few hundred tons a year, and in 1938 they failed entirely. Temporary revivals in domestic sales occurred in 1928 and 1933 following curtailments in imports of emery and corundum. (See fig. 4.)

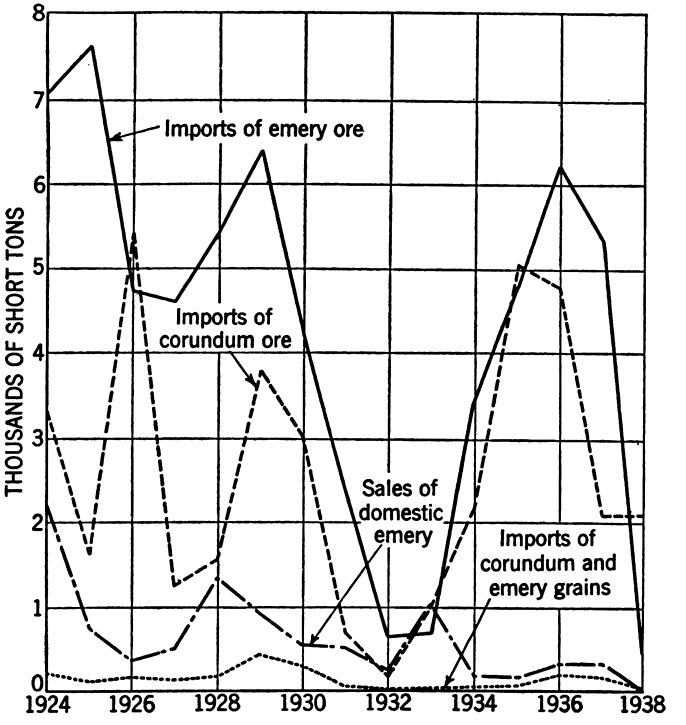


FIGURE 4.—Comparison of sales of domestic emery with imports of emery and corundum in the United States, 1924–38.

*Emery sold or used by producers in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 189 | $1,800 | 1937 | 320 | $2,780 |
| 1935 | 176 | 1,606 | 1938 | | |
| 1936 | 325 | 2,900 | | | |

## NATURAL CARBON ABRASIVES

*Abrasive or industrial diamond.*—The demand for industrial or abrasive diamond in the United States is met entirely by imports of black diamonds (carbonados) and bort. Black diamonds come chiefly from the State of Bahia (Brazil). Bort cull stones from the gem-diamond industry originate principally in the Union of South Africa. In 1938 imports of abrasive diamond into the United States were valued at $4,295,704, a decrease of nearly $2,500,000 from 1937. Declines occurred in the quantity of both bort and "glaziers' and engravers', unset, and miners' diamonds" imported. Imports of bort dropped 73 percent and those of the other classification 26 percent.

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Only slight declines occurred in the average values of the two types of industrial diamond, and these probably were due largely to lowered prices resulting from the lessened demand. Bort values fell from $17.38 per carat in 1937 to $16.67 in 1938; values of the other class dropped from $3.47 per carat in 1937 to $3.02 in 1938.

There were no known developments in 1938 in the domestic diamond-bearing district near Murfreesboro, Pike County, Ark.

## ARTIFICIAL ABRASIVES

The artificial-abrasive industry suffered a substantial set-back in 1938. Sales of silicon carbide, aluminum oxide, and metallic abrasives were less than in 1937, and those of the first two were even less than in 1936, reversing the upward trend in all three since 1933. The following table shows the sales of these three classes of abrasive materials for the 5-year period 1934–38.

*Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1934–38* [1]

| Year | Silicon carbide [2] | | Aluminum oxide [2] | | Metallic abrasives | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 18,038 | [3] $1,753,019 | 46,496 | [3] $3,665,226 | 10,312 | $554,452 | 74,846 | $5,972,697 |
| 1935 | 24,266 | [3] 2,164,728 | 49,990 | [3] 3,784,726 | 14,593 | 741,633 | 88,849 | 6,691,087 |
| 1936 | 29,342 | 2,139,919 | 69,825 | 3,913,155 | 24,667 | 1,221,912 | 123,834 | 7,274,986 |
| 1937 | [4] 30,365 | [4] 2,215,318 | [4] 86,401 | [4] 4,749,497 | 28,031 | 1,399,772 | 144,797 | 8,364,587 |
| 1938 | [4] 25,346 | [4] 1,904,925 | [4] 53,220 | [4] 3,098,132 | 25,771 | 1,234,977 | 104,337 | 6,238,034 |

[1] Bureau of Mines not at liberty to publish data for United States separately.
[2] Includes material used for refractories and other nonabrasive uses.
[3] Includes value of some grain.
[4] Production.

Production of silicon carbide centers in the Niagara Falls region in New York and that of aluminum oxide in the Niagara Falls region and at Anniston, Ala. Production of metallic abrasives is scattered through several Northern States from Michigan to New Hampshire. The following companies reported the manufacture of artificial abrasive materials in 1938.

SILICON CARBIDE:
The Carborundum Co., Niagara Falls, N. Y.
The Exolon Co., Blasdell, N. Y.
General Abrasive Co., Inc., College Avenue, Niagara Falls, N. Y.
Norton Co., 1 New Bond Street, Worcester, Mass.

ALUMINUM OXIDE:
Abrasive Co. of Canada, Ltd., Tacony and Fraley Streets, Bridesburg, Philadelphia, Pa. (or Arvida, Canada).
The Carborundum Co., Niagara Falls, N. Y.
The Exolon Co., Blasdell, N. Y.
General Abrasive Co., Inc., College Avenue, Niagara Falls, N. Y.
Monsanto Chemical Co., 1700 South Second Street, St. Louis, Mo.
Norton Co., 1 New Bond Street, Worcester, Mass.

METALLIC ABRASIVES:
Alloy Metal Abrasive Co., 311 West Huron Street, Ann Arbor, Mich.
The American Steel Abrasives Co., Galion, Ohio.
The Globe Steel Abrasive Co., Mansfield, Ohio.
The National Metal Abrasive Co., 3560 Norton Road, Cleveland, Ohio.
Pittsburgh Crushed Steel Co., Alleghany Valley Railroad and Sixty-first Street, Pittsburgh, Pa.
Steelblast Abrasives Co., Cleveland, Ohio.
Harrison Abrasive Corporation, Manchester, N. H.

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Tone [17] discussed in considerable detail the composition, hardness, crystal structure, and refractoriness of synthetic abrasive materials. Late in 1938 the National Bureau of Standards [18] issued a circular describing the manufacture of abrasive grain and abrasive products, with a bibliography of recent literature on abrasives. The production of silicon carbide, aluminum oxide, and boron carbide is described. Silicon carbide (SiC) is made in a resistance-type electric furnace, usually operated at an energy rate of 1,500 kilowatts, with a charge of approximately 60 percent silica and 40 percent low-ash petroleum coke to which are added variable quantities of ordinary wood sawdust and sodium chloride. Artificial corundum or "fused alumina" ($Al_2O_3$) is produced from calcined bauxite in steel-lined, water-cooled furnaces of the arc type. Coke and iron borings are added to the charge to aid in the reduction and separation of the impurities. Boron carbide ($B_4C$) is made in a resistance-type furnace with coke and dehydrated boric acid.

Metallic abrasives include crushed steel, steel shot, and angular steel grit. Crushed steel is made [19] from high-carbon and crucible sheet steel specially treated to impart brittleness. It is then crushed to sizes ranging from 2- to 200-mesh. After screening, each batch is heat-treated and separated into 25 sizes ranging from 20- to 200-mesh. Sizes from 70-mesh upward are screened on silk bolting cloth, and the finer sizes in powder form are used in steel cement, various chemical compounds, and fireworks sparklers.

Steel shot is merely chilled cast iron. Only raw materials of the highest grade, including selected scrap and charcoal iron, are used in its manufacture; these are melted in a cupola. During the casting period the molten metal is separated into small spherical globules by directing high-pressure steam or heated compressed air against the stream of metal. The globules are blown into water and cooled. The shot, made brittle by the rapid cooling, is heat-treated to impart a temper of hardness and graded by mechanical means into 15 sizes that range from 4- to 90-mesh. Coarse material left on the 4-mesh screen is granulated by specially designed crushing equipment and in this form is known as angular steel grit. The crushed material is heat-treated to impart toughness and durability, then graded into 15 sizes ranging from 7- to 100-mesh. Steel shot and angular steel grit are used for many abrasive purposes.

## MISCELLANEOUS ABRASIVE MATERIALS

Besides the materials already discussed several others are used for abrasive purposes. Several oxides—tin oxide, rouge and crocus (forms of ferric oxide), chromium oxide, magnesium oxide, manganese oxide, and lime—as well as clay, talc, and whiting, are used as polishing agents. Silt, clay, feldspar, and other substances sometimes are used as abrasives.

## FOREIGN TRADE [20]

The decline of nearly 3 million dollars in the total value of abrasive materials imported for consumption in the United States in 1938 from

[17] Tone, F. J., The Quest for Hard Materials: Ind. and Eng. Chem. (Ind. Ed.), vol. 30, No. 2, February 1938, pp. 232-242.
[18] National Bureau of Standards, Artificial Abrasives and Abrasive Products: Letter Circ. LC-540, Dec. 21, 1938, 8 pp.
[19] Abrasives, Metallic Abrasive Data Are Requested: Vol. 19, No. 6, June 1938, pp. 44, 46.
[20] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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that of 1937 was due principally to the decrease of nearly half a million carats in imports of glaziers' and engravers' (unset) and miners' diamonds. Imports of these types of diamonds, which constitute the greater part of the total value of all imported abrasives, declined from 1,885,970 carats valued at $6,542,365 in 1937 to 1,396,247 carats valued at $4,213,412 in 1938. Declines were registered also in imports of most other types of abrasives, but imports of garnets, rough or unmanufactured millstones, hones, oilstones, and whetstones, and corundum ore increased. Garnets were imported for the first time in several years. The declines in imports of corundum (and emery) grains, diamond dust, bort, and emery ore were especially marked.

The total value of exports of all recorded classes of natural abrasives in 1938 was less than in 1937, the decline in the values of grindstones and abrasive wheels (emery and corundum) being much greater than the increase in the value of the much larger remaining class, which includes all other natural abrasives.

*Abrasive materials imported for consumption in the United States, 1936–38, by kinds*

| Kind | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value |
| Millstones and burrstones: | | | | | | |
| Rough or unmanufactured short tons | | | | | 11 | $894 |
| Bound up into millstones do | 25 | $2,228 | 29 | $2,896 | 15 | 1,318 |
| Grindstones, finished or unfinished do | 815 | 24,638 | 963 | 32,445 | 657 | 22,431 |
| Hones, oilstones, and whetstones do | 87 | 41,252 | 69 | 43,470 | 101 | 44,142 |
| Emery: | | | | | | |
| Ore do | 6,217 | 77,548 | 5,357 | 87,557 | 477 | 7,796 |
| Grains, ground, pulverized, or refined pounds | [1] | [1] | [1] | [1] | [1] | [1] |
| Paper and cloth of emery or corundum | [2] | 18,215 | [2] | 31,937 | [2] | 21,137 |
| Wheels, files, and other manufactures of emery or corundum or garnet pounds | 136,966 | 78,677 | 123,106 | 72,925 | 79,901 | 49,146 |
| Corundum (see also "Emery"): | | | | | | |
| Ore short tons | 4,790 | 290,221 | 2,085 | 134,574 | 2,098 | 138,629 |
| Grains, ground, pulverized, or refined pounds | [1] 390,111 | [1] 30,125 | [1] 329,121 | [1] 29,445 | [1] 65,608 | [1] 6,155 |
| Garnet in grains, or ground, pulverized, etc. pounds | | | | | 3,696 | 193 |
| Tripoli and rottenstone short tons | 522 | 11,759 | 871 | 12,207 | 498 | 9,826 |
| Pumice: | | | | | | |
| Crude or unmanufactured do | 7,041 | 54,580 | 8,771 | 57,563 | 5,943 | 34,486 |
| Manufactures of, or of which pumice is the component material of chief value | [3] | 29,931 | [3] | 34,855 | [3] | 20,809 |
| Diamond: | | | | | | |
| Bort carats | 3,779 | 79,679 | 4,203 | 73,069 | 1,151 | 19,187 |
| Dust | [3] | 2,537 | [3] | 145,036 | [3] | 63,105 |
| Glaziers' and engravers', unset, and miners' carats | 1,166,094 | 4,328,603 | 1,885,970 | 6,542,365 | 1,396,247 | 4,213,412 |
| Flint, flints, and flint stones, unground short tons | 9,910 | 90,531 | 13,428 | 117,828 | 8,169 | 74,338 |
| | | 5,160,524 | | 7,418,172 | | 4,727,004 |

[1] Emery included with corundum; not separately classified.
[2] 2,494 reams in 1936; 3,276 reams in 1937; 1,924 reams in 1938; weight not recorded.
[3] Quantity not recorded.

*Value of domestic abrasive materials exported from the United States, 1934–38*

| Material | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Grindstones | $143,626 | $148,943 | $140,614 | $193,112 | $122,720 |
| Abrasive wheels, emery and corundum | 113,118 | 116,376 | 124,471 | 140,022 | 116,456 |
| All other natural abrasives, hones, whetstones, etc. | 254,515 | 250,228 | 277,463 | 826,955 | 835,894 |

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# SULFUR AND PYRITES

By Robert H. Ridgway and A. W. Mitchell

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Demand for sulfur was lower in 1938 than in 1937, and world production declined because of a smaller output in the United States. Production in Italy, the second largest source, increased moderately. Data for Japan, normally the third largest producer, are not available. Exports from the principal sources of supply decreased, owing not only to lower rate of consumption but also to increased recovery in some market areas of elemental sulfur as a byproduct in industrial processes. Germany, formerly a large market for native sulfur, has now developed a supply of elemental sulfur from byproduct sources adequate for its own increasing needs. Spain, Japan, and Norway were the largest producers of pyrites in 1938, but operations in Spain, the largest source, were hampered by the civil war.

Consumption of both sulfur and pyrites in the United States decreased in 1938. Probably the most significant event of 1938 in the domestic industry was the reduction in the quotations on sulfur at the beginning of the last quarter—the first change in the quotations since 1926. Maintenance of the price at $18 per long ton throughout the good years as well as the depression has made the market attractive and has resulted in technical investigations into sulfur production, as well as research for substitutes and substitute processes which have been somewhat successful. Apparently pressure resulting from increased production of byproduct sulfur and additional domestic production of native sulfur affected the change in sulfur quotations. While domestic production dropped in 1938 shipments recorded an even greater decline, resulting in record stocks at the mines.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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*Salient statistics of the sulfur industry in the United States, 1925–29 (average) and 1935–38*

| | 1925–29 (Average) | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Sulfur: | | | | | |
| Production of crude sulfur..long tons.. | 1,951,034 | 1,632,590 | 2,016,338 | 2,741,970 | 2,393,408 |
| Shipments of crude sulfur: | | | | | |
| For domestic consumption..do.... | 1,397,411 | 1,232,607 | 1,421,621 | 1,791,215 | 1,052,890 |
| For export.....do.... | 707,175 | 402,383 | 547,199 | 675,297 | 575,957 |
| Total shipments.....do.... | 2,104,586 | 1,634,990 | 1,968,820 | 2,466,512 | 1,628,847 |
| Imports.....do.... | 1,896 | 1,763 | 530 | 398 | 51 |
| Exports of treated sulfur.....do.... | 11,956 | 10,916 | 19,708 | 13,533 | 12,707 |
| Producers' stocks at end of year..do.... | 2,413,000 | 3,100,000 | 3,100,000 | 3,400,000 | 4,200,000 |
| Price of crude sulfur f. o. b. mines, per long ton..... | $17.50 | $18 | $18 | $18 | $16–$18 |
| Pyrites: | | | | | |
| Production.....long tons.. | 273,936 | 514,192 | 547,236 | 584,166 | 555,629 |
| Imports.....do.... | 372,958 | 397,113 | 429,313 | 524,430 | 334,234 |
| Price of imported pyrites c. i. f. Atlantic ports..cents per long-ton unit.. | 12–13 | 12–13 | 12–13 | 12–13 | 12–13 |
| Sulfuric acid: Production of byproduct sulfuric acid (60° B.) at copper and zinc plants.....short tons.. | 1,118,453 | 603,627 | 732,620 | 833,994 | (1) |

[1]Figures not yet available.

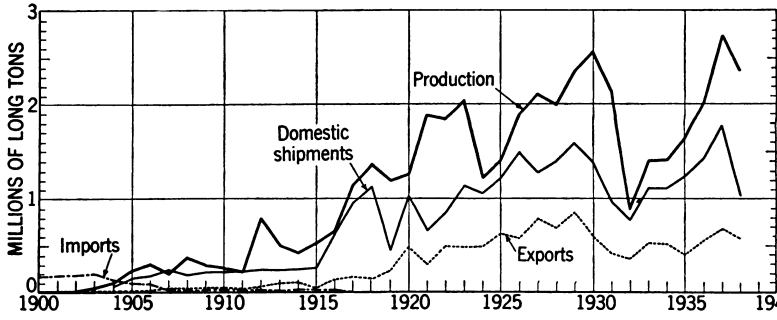


FIGURE 1.—Domestic production, domestic shipments, exports, and imports of crude sulfur, 1900–1938.

The production of native sulfur in the United States up to and including 1938 has totaled more than 43 million long tons. Virtually the entire output has been made since 1900. The principal trends in the sulfur and pyrites industries are shown in figures 1 and 2.

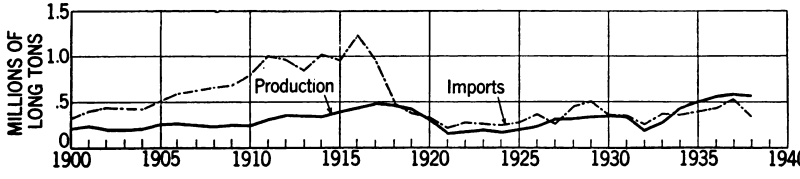


FIGURE 2.—Domestic production and imports of pyrites, 1900–1938.

## SULFUR

*Domestic production.*—Production of sulfur in the United States in 1938 decreased 13 percent from the record total in 1937. Curtailment of shipments from domestic mines, however, was more severe, comprising 34 percent of the record figure in 1937. Several hundred tons of sulfur-bearing ore used for agricultural purposes are not included in the total for 1937. None of this material was reported in 1938.

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*Sulfur produced and shipped in the United States, 1934–38*

| Year | Produced (long tons) | Shipped | | Year | Produced (long tons) | Shipped | |
|---|---|---|---|---|---|---|---|
| | | Long tons | Approximate value | | | Long tons | Approximate value |
| 1934 | 1,421,473 | 1,613,838 | $28,900,000 | 1937 | 2,741,970 | 2,466,512 | $44,300,000 |
| 1935 | 1,632,590 | 1,634,990 | 29,300,000 | 1938 | 2,393,408 | 1,628,847 | 27,300,000 |
| 1936 | 2,016,338 | 1,968,820 | 35,400,000 | | | | |

Eighty-six percent of the domestic output of sulfur reported for 1938 came from Texas and the bulk of the remainder from Louisiana. California and Utah produced only 4,158 long tons. Thus, the first two States produced more than 99 percent of the domestic output. Active mines in 1938 are listed in the following table.

*Mines that produced sulfur in the United States in 1938*

| Operating company | Name of mine | Location of mine |
|---|---|---|
| California: | | |
| Nevada Pacific Sulphur Co | Gup No. 1 | Oasis, Inyo County. |
| Western Mining Corporation | Crater | Bigpine, Inyo County. |
| Louisiana: | | |
| Freeport Sulphur Co | Grande Ecaille | Port Sulphur, Plaquemines Parish. |
| Texas: | | |
| Duval Texas Sulphur Co | Boling Dome | Boling, Wharton County. |
| Do | Orchard Dome | Orchard, Fort Bend County. |
| Freeport Sulphur Co | Hoskins Mound | Freeport, Brazoria County. |
| Jefferson Lake Oil Co., Inc | Clemens Dome | Brazoria, Brazoria County. |
| Texas Gulf Sulphur Co | Boling Dome | Newgulf, Wharton County. |
| Do | Long Point Dome | Needville, Fort Bend County. |
| Utah: Utah Sulphur Industries | Utah Sulphur Industries. | Beaver, Beaver County. |

*Byproduct sulfur.*—A small quantity of byproduct sulfur is produced annually incident to the purification of manufactured fuel gases. In 1938, 3,674 long tons were produced from this source, of which 2,507 tons were shipped; the rest is stored or accumulated in dumps at various plants. Several processes are used. The largest quantity is recovered by the Thylox process,[2] although a considerable quantity is recovered by the Ferrox process. The product is shipped either as 99 percent or more pure sulfur or as a sludge or paste containing 33 to 50 percent sulfur. The output is not included in the sulfur-production figures of the United States.

The conversion of waste material, which may be somewhat of a nuisance, into a marketable product is the object of a study conducted by the Bureau of Mines, designed to recover sulfur from smelter smoke.[3]

*Stocks.*—As production exceeded shipments in 1938, stocks at the mines increased during the year and on December 31 amounted to 4,200,000 long tons.

*Price.*—The price of sulfur was reduced in 1938—the first change in the quotations since 1926. The price at the mines dropped from

[2] Foxwell, G. E., and Grounds, A., Thylox Process for the Recovery of Sulfur from Gases Containing Hydrogen Sulfide: Chem. and Ind., vol. 58, No. 8, Feb. 25, 1939, pp. 163–170.

[3] Roberson, A. H., and Marks, G. W., Fixation of Sulfur from Smelter Smoke: Progress Reports—Metallurgical Division, No. 26: Bureau of Mines Rept. of Investigations 3415, 1938, pp. 1–45.

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$18 to $16 per long ton at the beginning of the last quarter, while the ex-vessel quotation along the Atlantic seaboard was reduced from $22 to $20.50 at all ports except Boston, Mass., and Portland, Maine. where the price was $22.50.

*Byproduct sulfuric acid.*—Treatment of copper and zinc ores yields large quantities of sulfur, which is recovered at the mills as a pyrites concentrate or at the smelters as sulfuric acid. Production of pyrites concentrate is discussed in the pyrites section of this report. In smelting copper and zinc concentrates the sulfur is driven off as sulfur dioxide gas, which is used at many smelters in the manufacture of sulfuric acid. The equivalent of about 155,000 long tons of sulfur was recovered as sulfuric acid annually from this source during the 3 years ended in 1937. Such sulfur is not included in the sulfur production figures for the United States, but the following table shows the output of byproduct acid at both copper- and zinc-smelting plants. The acid reported is only that made from the sulfur content of sulfide ores. The figures for 1934 to 1937, inclusive, do not include the acid made from the pyrites concentrate in Tennessee but do include the relatively small amount of acid made from pyrites concentrate in Wisconsin. For 1933 pyrites acid from both States is included.

*Byproduct sulfuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1933–37, in short tons* [1]

| | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Copper plants | [2] 301,075 | 168,676 | 160,151 | 226,738 | [2] 291,638 |
| Zinc plants | 355,027 | 406,984 | 443,476 | 505,882 | 542,356 |
| | [2] 656,102 | 575,660 | 603,627 | 732,620 | [3] 833,994 |

[1] Figures for 1938 not yet available.
[2] Includes acid made from pyrites concentrates in Tennessee.
[3] Includes a small amount of sulfuric acid produced as a byproduct in the roasting of high-sulfide gold and silver concentrates.

Processes recently have been developed for the recovery of sulfuric acid in the treatment of natural gases and refinery gases to remove hydrogen sulfide, and plants utilizing these processes are now operating. Acid from this source is not included in the byproduct acid figures in the preceding table.

*Consumption.*—The apparent domestic consumption of sulfur in 1938 dropped 41 percent below the record level in 1937.

*Apparent consumption of sulfur in the United States, 1934–38, in long tons*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Shipments | 1,613,838 | 1,634,990 | 1,968,820 | 2,466,512 | 1,628,847 |
| Imports | 5,839 | 1,763 | 530 | 398 | 51 |
| | 1,619,677 | 1,636,753 | 1,969,350 | 2,466,910 | 1,628,898 |
| Exports: | | | | | |
| Crude | 507,115 | 402,383 | 547,199 | 675,297 | 575,957 |
| Refined | 10,112 | 10,916 | 19,708 | 13,533 | 12,707 |
| | 517,227 | 413,299 | 566,907 | 688,830 | 588,664 |
| Apparent consumption | 1,102,450 | 1,223,454 | 1,402,443 | 1,778,080 | 1,040,234 |

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The consumption of sulfur in various industries from 1934 through 1938 has been estimated by Chemical and Metallurgical Engineering as follows:

*Sulfur consumed in the United States, 1934–38, by uses, in long tons* [1]

| Use | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Chemicals | 512,000 | 555,000 | 620,000 | 777,000 | 484,000 |
| Fertilizer and insecticides | 247,000 | 239,000 | 266,000 | 415,000 | 220,000 |
| Pulp and paper | 176,000 | 204,000 | 260,000 | 302,000 | 174,000 |
| Explosives | 43,000 | 42,000 | 53,000 | 68,000 | 50,000 |
| Dyes and coal-tar products | 34,000 | 39,000 | 46,000 | 49,000 | 40,000 |
| Rubber | 30,000 | 33,000 | 39,000 | 37,000 | 29,000 |
| Paint and varnish | 4,000 | 48,000 | 54,000 | 64,000 | 50,000 |
| Food products | 4,000 | 4,000 | 4,500 | 6,000 | 5,500 |
| Miscellaneous | 60,000 | 68,500 | 78,000 | 82,000 | 47,500 |
| | 1,110,000 | 1,232,500 | 1,420,500 | 1,800,000 | 1,100,000 |

[1] Figures for 1937 and 1938 are not truly representative of consumption but rather of shipments to these specified industries. In 1938 consumers carried over large stocks from 1937, so that actual consumption in 1937 was less than the figures indicate and consumption in 1938 was larger than the above total.

Production of sulfuric acid, the chief use of sulfur in the United States, declined in 1938, reflecting the decreased consumption of chemicals. Consumption of acid in the domestic fertilizer industry, the largest outlet, dropped owing to the reduction in production of superphosphate. The T. V. A. continued its researches into the manufacture of phosphate fertilizers and announced successful operation of a small commercial-sized unit for the manufacture of calcium metaphosphate, a highly concentrated material containing 28 percent phosphorus, which uses phosphorus produced by electric furnaces.[4] Activities in the petroleum-refining industry, the second largest consumer of sulfuric acid, held up rather well, resulting in a relatively small decline in acid consumption. This industry, however, is also a potential source of acid, and several plants are producing acid as a byproduct in the treatment of refinery and natural gases.

The consumption of sulfuric acid, by industries, from 1934 through 1938 has been estimated by Chemical and Metallurgical Engineering as follows:

*Sulfuric acid (expressed as 50° B.) consumed in the United States, 1934–38, by industries, in short tons*

| Industry | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Fertilizer | 1,650,000 | 1,720,000 | 1,987,000 | 2,510,000 | 2,100,000 |
| Petroleum refining | 1,100,000 | 980,000 | 1,100,000 | 1,210,000 | 1,120,000 |
| Chemicals | 910,000 | 940,000 | 955,000 | 1,020,000 | 790,000 |
| Coal products | 500,000 | 625,000 | 770,000 | 860,000 | 585,000 |
| Iron and steel | 475,000 | 630,000 | 770,000 | 850,000 | 500,000 |
| Other metallurgical | 400,000 | 520,000 | 560,000 | 620,000 | 350,000 |
| Paints and pigments | 330,000 | 400,000 | 450,000 | 525,000 | 430,000 |
| Explosives | 180,000 | 175,000 | 222,000 | 230,000 | 185,000 |
| Rayon and cellulose film | 256,000 | 303,000 | 330,000 | 380,000 | 310,000 |
| Textiles | 75,000 | 90,000 | 108,000 | 112,000 | 90,000 |
| Miscellaneous | 290,000 | 342,000 | 380,000 | 400,000 | 300,000 |
| | 6,166,000 | 6,725,000 | 7,632,000 | 8,717,000 | 6,760,000 |

[4] Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1938: Washington, D. C., 1938, p. 32.

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The leading domestic producers have carried on research work with a view to broadening the market for sulfur, but to date no large-tonnage outlet has been developed. New applications for sulfur have been discussed by Duecker.[5]

*Foreign trade.*—Exports of sulfur in 1938 dropped 15 percent from the 1937 figure but were larger than in any other year since 1930; data by years from 1934 to 1938, inclusive, follow.

*Sulfur imported into and exported from the United States, 1934–38*

| Year | Imports | | Exports | | | |
|---|---|---|---|---|---|---|
| | Ore | | Crude | | Crushed, ground, refined, sublimed, and flowers of | |
| | Long tons | Value | Long tons | Value | Long tons | Value |
| 1934 | 5,839 | $76,631 | 507,115 | $9,364,501 | 10,112 | $398,043 |
| 1935 | 1,763 | 26,164 | 402,383 | 7,582,293 | 10,916 | 418,532 |
| 1936 | 530 | 10,141 | 547,199 | 10,147,038 | 19,708 | 746,985 |
| 1937 | 398 | 4,724 | 675,297 | 12,155,253 | 13,533 | 509,133 |
| 1938 | 51 | 562 | 575,957 | 10,332,529 | 12,707 | 469,773 |

Shipments of crude sulfur to Canada, formerly the largest market, fell abruptly in 1938 and amounted to only 43 percent of the 1937 figure. Australia increased its takings 52 percent over 1937 and became the largest customer. Canada, however, continued as the largest market for treated sulfur. The following table shows the distribution of exports by countries of destination for 1937 and 1938.

*Sulfur exported from the United States, 1937–38, by countries*

| Country | Crude | | | | Crushed, ground, refined, sublimed, and flowers of | | | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | | 1938 | | 1937 | | 1938 | |
| | Long tons | Value | Long tons | Value | Pounds | Value | Pounds | Value |
| North America: | | | | | | | | |
| Canada | 193,947 | $3,527,480 | 82,651 | $1,486,463 | 6,537,308 | $130,188 | 5,236,975 | $107,157 |
| Central America | 125 | 4,037 | 118 | 3,632 | 329,763 | 8,269 | 282,469 | 7,083 |
| Mexico | 9,394 | 193,181 | 5,946 | 124,435 | 1,813,162 | 34,329 | 1,556,482 | 32,216 |
| Newfoundland and Labrador | 8,519 | 157,073 | 2,989 | 53,802 | 2,800 | 71 | 4,000 | 163 |
| West Indies | 9,897 | 191,638 | 8,575 | 160,837 | 931,842 | 23,083 | 211,715 | 5,290 |
| | 221,882 | 4,073,409 | 100,279 | 1,829,169 | 9,614,875 | 195,940 | 7,291,641 | 151,909 |
| South America: | | | | | | | | |
| Argentina | 8,450 | 152,100 | 16,102 | 288,969 | 15,386 | 2,238 | 81,529 | 2,777 |
| Brazil | 70 | 1,792 | 4,106 | 82,715 | 477,744 | 7,666 | 359,867 | 6,805 |
| Colombia | (1) | 28 | ------ | ------ | 404,129 | 10,584 | 443,427 | 12,041 |
| Uruguay | 1,000 | 18,000 | ------ | ------ | ------ | ------ | ------ | ------ |
| Other South America | ------ | ------ | ------ | ------ | 219,435 | 3,906 | 242,905 | 4,118 |
| | 9,520 | 171,920 | 20,208 | 371,684 | 1,116,694 | 24,394 | 1,127,728 | 25,741 |
| Europe: | | | | | | | | |
| Belgium | 1,004 | 19,578 | 6,032 | 113,387 | 158,864 | 2,380 | 101,798 | 1,390 |
| Denmark | ------ | ------ | ------ | ------ | 1,132,449 | 14,146 | 1,361,579 | 17,090 |
| France | 107,111 | 1,937,343 | 98,751 | 1,826,896 | 739,979 | 10,150 | 522,049 | 6,807 |
| Germany | 47,349 | 874,721 | 32,817 | 610,750 | 1,578,797 | 21,179 | 454,148 | 5,919 |

[1] Less than 1 ton.

[5] Duecker, W. W., New Applications of Sulfur: Min. and Met., vol. 19, No. 383, November 1938, pp. 473–476.

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*Sulfur exported from the United States, 1937–38, by countries*—Continued

| Country | Crude | | | | Crushed, ground, refined, sublimed, and flowers of | | | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | | 1938 | | 1937 | | 1938 | |
| | Long tons | Value | Long tons | Value | Pounds | Value | Pounds | Value |
| Europe—Continued. | | | | | | | | |
| Netherlands | 20,714 | $386,357 | 21,663 | $418,980 | 625,004 | $7,697 | 1,009,701 | $12,672 |
| Sweden | 4,883 | 87,894 | 5,993 | 106,199 | 467,149 | 5,641 | 676,783 | 8,499 |
| United Kingdom | 104,067 | 1,823,869 | 95,985 | 1,568,570 | 5,496,937 | 70,312 | 4,935,464 | 65,730 |
| Other Europe | 12,657 | 227,826 | 8,400 | 149,800 | 1,855,031 | 25,489 | 2,089,286 | 27,439 |
| | 297,785 | 5,357,588 | 269,641 | 4,794,582 | 12,054,210 | 156,994 | 11,150,808 | 145,546 |
| Asia | 13,006 | 228,252 | 8,832 | 180,468 | 1,988,854 | 34,550 | 2,986,877 | 46,917 |
| Africa: | | | | | | | | |
| Algeria | 10,502 | 174,387 | 14,057 | 261,903 | | | | |
| Mozambique | | | | | 497,337 | 9,627 | 359,267 | 6,444 |
| Union of South Africa | 16,612 | 291,373 | 11,298 | 203,364 | 1,524,929 | 27,456 | 1,250,551 | 24,803 |
| Other Africa | | | 10 | 250 | 60,588 | 1,175 | 189,595 | 2,942 |
| | 27,114 | 465,760 | 25,365 | 465,517 | 2,082,854 | 38,258 | 1,799,413 | 34,189 |
| Oceania: | | | | | | | | |
| Australia | 71,334 | 1,241,116 | 108,465 | 1,928,755 | 3,194,885 | 50,828 | 3,805,520 | 56,529 |
| New Zealand | 34,656 | 617,208 | 43,167 | 762,354 | 260,597 | 8,154 | 299,768 | 8,924 |
| Other Oceania | | | | | 1,409 | 15 | 1,200 | 18 |
| | 105,990 | 1,858,324 | 151,632 | 2,691,109 | 3,456,891 | 58,997 | 4,106,488 | 65,471 |
| | 675,297 | 12,155,253 | 575,957 | 10,332,529 | 30,314,378 | 509,133 | 28,462,955 | 469,773 |

## THE INDUSTRY IN 1938, BY STATES

*California.*—Two operators in California reported production in 1938, but by far the larger output came from the Crater Group mine, Inyo County operated by the Western Mining Corporation.

*Louisiana.*—Production of sulfur in Louisiana in 1938 totaled 328,405 long tons and was made by the Freeport Sulphur Co. from its operations at Grand Ecaille, Plaquemines Parish, where further plant improvements were under way during the year.

An amendment to the Louisiana Constitution adopted November 8, 1938, provided that the State Severance Tax shall not exceed $1.03 per long ton, effective as of July 27, 1938. The previous tax was $2 per ton. The amendment also provides for an ad-valorem tax on unmined sulfur previously exempt.

*Texas.*—Texas supplied 86 percent of the domestic output in 1938. Six operations contributed to the total, but the largest output came from the Boling Dome property of the Texas Gulf Sulphur Co. The following table, compiled from information issued by the Texas State Comptroller's Office, shows the quarterly production of sulfur in Texas for 1938.

*Sulfur produced in Texas in 1938, by companies, in long tons*

| Company | First quarter | Second quarter | Third quarter | Fourth quarter | Total |
|---|---|---|---|---|---|
| Texas Gulf Sulphur Co | 399,626 | 318,210 | 268,882 | 235,902 | 1,222,620 |
| Freeport Sulphur Co | 91,160 | 91,095 | 88,915 | 84,615 | 355,785 |
| Jefferson Lake Oil Co., Inc | 58,825 | 56,803 | 52,319 | 100,182 | 268,129 |
| Duval Texas Sulphur Co | 35,461 | 56,000 | 62,870 | 58,075 | 212,406 |
| | 585,072 | 522,108 | 472,986 | 478,774 | 2,058,940 |

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The Texas Gulf Sulphur Co. also produced at Long Point Dome where operations were suspended during 1938 owing to exhaustion of sulfur on the tract then operated. The Freeport Sulphur Co., the second largest producer, continued operations at Hoskins Mound. Output at Clemens Dome, Brazoria County, which was begun in 1937 by the Jefferson Lake Oil Co., Inc., increased substantially in 1938 when additional capacity was installed. In addition to its output on certain tracts on Boling Dome, the Duval Texas Sulphur Co. inaugurated production at Orchard Dome, Fort Bend County, in 1938.

*Utah.*—Sulfur production in Utah in 1938 came from the Utah Sulphur Industries plant at Beaver, Beaver County.

## WORLD PRODUCTION

World production of sulfur in 1938, including elemental sulfur recovered in the treatment of pyrites and as a byproduct from the manufacture of gas and gasoline in Germany, is estimated at 3,200,000 long tons. The following table shows the output of native sulfur for the world from 1934 through 1938.

*World production of native sulfur, 1934–38, in long tons* [1]

[Compiled by R. B. Miller]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Argentina | | 7 | | (2) | (2) |
| Bolivia (exports) | 5,620 | 4,183 | 935 | 1,712 | 1,632 |
| Chile | 20,356 | [3] 19,792 | [3] 25,525 | [3] 22,345 | (2) |
| China | 4,393 | (2) | (2) | (2) | (2) |
| Ecuador | 91 | 118 | 59 | 54 | 68 |
| France (content of ore) | 69 | 64 | 123 | 157 | (2) |
| Greece | 105 | 23 | 150 | 67 | (2) |
| Guatemala | | | 16 | 11 | (4) |
| Italy (crude) [5] | 337,966 | 307,024 | 322,396 | 338,101 | 370,913 |
| Japan [6] | 133,273 | 162,341 | 172,545 | (2) | (2) |
| Mexico | 846 | [7] 3,206 | [7] 1,272 | (2) | 49 |
| Netherland East India | 12,047 | 9,492 | 11,311 | 12,474 | (2) |
| Palestine | | 561 | 79 | 494 | 1,196 |
| Peru | 1,455 | 2,117 | 1,696 | 1,551 | 2,813 |
| Spain (refined) [8] | 31,130 | (2) | (2) | (2) | (2) |
| Taiwan | 1,062 | 1,054 | 1,207 | (2) | (2) |
| Turkey | 86 | 1,072 | 3,081 | 2,694 | (2) |
| United States | 1,421,473 | 1,632,590 | 2,016,338 | 2,741,970 | 2,393,408 |

[1] Sulfur is also believed to be produced in the U. S. S. R., but the amount of its production is unknown.
[2] Data not available.
[3] In addition, the following quantities of sulfur rock are reported: 1935, 4,785 tons (77.5 percent sulfur); 1936, 11,612 tons (40–80 percent sulfur); and 1937, 1,050 tons.
[4] Less than 1 ton.
[5] In addition, the following quantities of sulfur rock are reported: 1934, 21,820 tons; 1935, 18,738 tons; 1936, 20,743 tons; and 1937, 19,793 tons.
[6] In addition, the following quantities of sulfur rock are reported: 1934, 4,706 tons; 1935, 20,764 tons; and 1936, 31,576 tons. Similar data are not available for 1937–38.
[7] Crude sulfur product.
[8] Refined sulfur, exclusive of that made from imported crude sulfur.

*Canada.*—Elemental sulfur is being produced in the treatment of base-metal smelter gas at Trail, British Columbia, by the Consolidated Mining & Smelting Co. The first commercial unit went into production in 1936,[6] and 12,083 long tons were produced in 1937. Data on output in 1938 are not available, but a 50-ton-per-day unit was added to the plant capacity. The Aldermac Mines, Ltd., is planning to recover sulfur by the Comstock-Westcott process from the cupriferous

[6] Kirkpatrick, S. D., Trail Solves Its Sulfur Problem: Chem. and Met. Eng., vol. 45, No. 9, September 1938, pp. 483–485.

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pyrite output of the Aldermac mine near Rouyn, Beauchastel Township, Quebec. Imports of sulfur into Canada dropped sharply in 1938, amounting to only 83,658 long tons compared with 201,504 tons in 1937.

*Chile.*—The Chilean Government is interested in promoting the production of sulfur both directly and through such semiofficial institutions as the Miners Credit Bank. Data on production for 1938 are not yet available, but the total may reach 20,000 long tons. Exports, however, were much lower than in 1937, amounting to only 3,794 tons for the first 11 months compared with 19,378 tons for the same period in 1937.

*Germany.*—Germany produces no native sulfur, and in the past its requirements have been met by imports, largely from the United States; imports in 1938 were 101,958 long tons, of which 65 percent came from Italy. Much of the sulfur imported into Germany is transshipped to nearby countries; exports in 1938 were 22,876 tons. In recent years the production of byproduct sulfur has been making rapid progress, and by 1940 Germany may be self-sufficient. It is believed that output of elemental sulfur in 1938 from all sources, notably from coking plants, low-temperature carbonization plants, and gasoline hydrogenation plants, may have reached 70,000 tons or nearly two-thirds of requirements. Formerly nearly the entire German output of elemental sulfur came from desulfurization at coke plants, but most of the gain in production recently has been the result of installation of improved recovery methods at gasoline hydrogenation plants, now the main source of supply.

*Iceland.*—A plant for the production of sulfur at Myvatan was under construction late in 1938. Plans call for an output of 4,000 long tons a year from deposits in northern Iceland.

*Italy.*—Italy, including Sicily, is the world's second-largest producer of sulfur. Production in 1938 was 370,913 long tons compared with 338,101 tons in 1937. Exports of crude and refined sulfur from Italy dropped sharply from 384,067 tons in 1937 to 223,804 tons in 1938.

*Japan.*—Data on the production of sulfur in Japan in 1938 are not available; exports were 31,012 long tons compared with 54,961 tons in 1937.

*Norway.*—Production of sulfur in Norway results from the treatment of cupriferous pyrites at the Thamshavn plant of the Orkla Metal Co. Output was at a lower level in 1938 than in 1937. Exports in 1938 were 75,420 long tons compared with 95,695 tons in 1937. Although Norway has been an exporter of sulfur since 1932, it continues to import sulfur; imports in 1938 were 6,553 tons.

*Portugal.*—Production of elemental sulfur from pyrites at the San Domingos mine in the Province of Alemtejo was begun in 1935. Output in 1938 was 11,059 long tons compared with 13,021 tons in 1937; imports in 1938 were 3,408 tons compared with 2,336 tons in 1937.

*Spain.*—The output of native sulfur in Spain is augmented by elemental sulfur obtained in the treatment of pyrites. Figures for recent years are not available.

*Sweden.*—Elemental sulfur recovered as a byproduct of smelter gases by the Boliden Co.[7] at Ronskar in North Sweden is the only sulfur produced in Sweden. Output at this plant was 17,512 long

[7] Palen, A. G. Paul, Boliden Improves Work at Ronskar Smelter: Eng. and Min. Jour., vol. 139, No. 9, September 1938, pp. 54–55.

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tons in 1938 compared with 18,141 tons in 1937. Imports of sulfur in 1938 were 47,309 tons compared with 83,009 tons in 1937.

## PYRITES

*Domestic production.*—Production of pyrites (ores and concentrates) in the United States in 1938 dropped 5 percent from the record figures in 1937 but was greater than in any other year. Of the 1938 total, 101,701 long tons were lump, and the rest was fines; most of the fines were flotation concentrates.

*Pyrites (ores and concentrates) produced in the United States, 1934–38*

| Year | Quantity | | Value | Year | Quantity | | Value |
|---|---|---|---|---|---|---|---|
| | Gross weight (long tons) | Sulfur content (percent) | | | Gross weight (long tons) | Sulfur content (percent) | |
| 1934 | 432,524 | 38.8 | $1,216,363 | 1937 | 584,166 | 39.7 | $1,777,787 |
| 1935 | 514,192 | 39.5 | 1,583,074 | 1938 | 555,629 | 39.4 | 1,685,766 |
| 1936 | 547,236 | 39.6 | 1,666,194 | | | | |

The quantity of pyrites (ores and concentrates) sold or consumed by producing companies totaled 524,120 long tons in 1938 compared with 568,470 tons in 1937. In 1938, 163,711 tons were sold by producers compared with 181,322 tons in 1937. All sales in both years were to domestic consumers. Prices quoted by trade journals are for imported pyrites and are given in cents per long-ton unit, c. i. f. Atlantic ports; quotations, which are nominal, were unchanged at 12–13 cents per long-ton unit throughout the year.

Tennessee was the principal producing State in 1938; other States producing were California, Colorado, Illinois, Kansas, Missouri, Montana, New York, Virginia, and Wisconsin.

### THE INDUSTRY IN 1938, BY STATES

*California.*—The Mountain Copper Co. was the only producer of pyrites in California in 1938; output came from the Hornet mine in Shasta County.

*Colorado.*—One operator shipped pyrites concentrates in Colorado in 1938. No pyrites was shipped from the mill-tailings dump of the Colorado zinc-lead mill in Lake County during the year.

*Illinois.*—In 1938 two coal operators in Illinois, the Peabody Coal Co. in Christian County and the Midland Electric Coal Corporation in Henry County, produced and shipped pyrites (coal brasses) recovered as a byproduct in coal-cleaning operations. The pyrites was used in the manufacture of sulfuric acid.

*Kansas.*—The Mineral Products Co. produced 17,757 long tons of pyrites (coal brasses) in 1938 at West Mineral, Cherokee County. Shipments, which averaged 47 percent sulfur, were consigned to St. Louis, Mo., where they were used in acid making.

*Missouri.*—Two operators produced and shipped 28,828 long tons of pyrites—the total output of Missouri in 1938. Shipments averaged

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48.8 percent sulfur and moved to acid plants in the St. Louis area. The largest producer was the Moselle No. 10 mine in Phelps County, operated by Thomas and Williams. Other production came from the Judith Spring mine in Franklin County, operated by Julian Pickles.

*Montana.*—The pyrites produced in Montana in 1938 came from the Anaconda Copper Mining Co. at Anaconda, where it is recovered as a flotation concentrate in copper-plant operation.

*New York.*—During 1938 the St. Joseph Lead Co. produced 63,772 long tons of pyrites concentrate at its Balmat Mill in St. Lawrence County. The pyrites, which ran 49.72 percent sulfur, was produced as a flotation concentrate in the treatment of ore in which zinc is the principal value.

*Tennessee.*—The pyrites produced in Tennessee in 1938 came from the operations of the Tennessee Copper Co. in the Ducktown Basin, Polk County. It is produced as a flotation concentrate but does not enter the market, as the entire output is used by the company in the manufacture of sulfuric acid.

*Virginia.*—The only pyrites mined in Virginia in 1938 came from the Gossan mine at Cliffview, Carroll County, operated by the General Chemical Co., where a new mill was put into operation late in the year. The ore is mined by underground methods, and before the new mill was in operation lump ore was shipped. The entire output is used for the manufacture of sulfuric acid in the company plant at Pulaski.

*Wisconsin.*—The only company reporting pyrites production in Wisconsin in 1938 was the Vinegar Hill Zinc Co. in Grant County, which makes a pyrites concentrate in its magnetic separation plant at Cuba City from ore from several mines in the Platteville district.

## FOREIGN TRADE

Imports of pyrites in 1938 fell off 36 percent from the 1937 figure. Despite the civil war, Spain continued to supply the bulk of our imports; much smaller amounts came from Canada and Mexico. No pyrites has been exported since 1931.

*Pyrites, containing more than 25 percent sulfur, imported into the United States, 1934–38, by countries*

| Country | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value |
| Belgium | | | | | 5,290 | $29,756 | | | | |
| Canada | 19,341 | $83,086 | 9,888 | $45,965 | 55,105 | 200,184 | 20,558 | $74,946 | 30,064 | $135,659 |
| Mexico | | | 85 | 430 | | | 549 | 1,473 | 202 | 522 |
| Portugal | | | | | 59,804 | 286,974 | 21,725 | 109,395 | | |
| Spain | 346,974 | 1,162,574 | 387,140 | 1,266,606 | 309,114 | 913,820 | 481,598 | 1,158,671 | 303,968 | 709,983 |
| | 366,315 | 1,245,660 | 397,113 | 1,313,001 | 429,313 | 1,430,734 | 524,430 | 1,344,485 | 334,234 | 846,164 |

The bulk of the imports of pyrites moves into Philadelphia and Maryland, where it is used in the manufacture of sulfuric acid.

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*Pyrites, containing more than 25 percent sulfur, imported into the United States, 1934–38, by customs districts, in long tons*

| Customs district | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Buffalo | 44 | 94 | 140 | 584 | 5,130 |
| Chicago | | 2,704 | | | |
| Georgia | 3,530 | 4,002 | 2,500 | 4,795 | |
| Los Angeles | | 848 | | | |
| Maryland | 162,183 | 182,333 | 172,290 | 220,430 | 113,838 |
| New York | 46,359 | 56,725 | 60,041 | 64,621 | 55,830 |
| Ohio | 12,668 | | | | |
| Philadelphia | 116,361 | 129,793 | 158,088 | 194,680 | 130,703 |
| San Diego | | 85 | | 549 | 202 |
| South Carolina | 11,541 | 7,681 | 9,429 | 9,519 | 5,265 |
| Vermont | 6,629 | 6,242 | 17,449 | 19,074 | 15,713 |
| Virginia | 7,001 | 6,606 | 9,376 | 9,278 | 7,553 |
| | 366,315 | 397,113 | 429,313 | 524,430 | 334,234 |

## WORLD PRODUCTION

The following table shows world production of pyrites and its sulfur content. Most of the figures are taken from official sources of the countries concerned, supplemented by information from publications of the Imperial Institute and other reliable sources.

*World production of pyrites (including cupreous pyrites), 1936–38, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Gross weight | Sulfur content | Gross weight | Sulfur content | Gross weight | Sulfur content |
| Algeria | 19,965 | 9,184 | 38,760 | 17,830 | 44,750 | 20,585 |
| Australia (Tasmania) | 34,252 | (2) | 41,282 | (2) | (2) | (2) |
| Canada | 115,404 | 57,305 | 108,370 | 54,595 | 40,464 | 20,300 |
| Chosen | 78,036 | (2) | 79,500 | (2) | (2) | (2) |
| Cyprus [3] | 223,904 | 111,952 | 395,076 | 193,587 | (2) | (2) |
| Czechoslovakia | 19,084 | 8,017 | 18,361 | 7,712 | (2) | (2) |
| Finland | 78,720 | 34,401 | 91,311 | 39,264 | (2) | (2) |
| France | 148,025 | 66,043 | 145,820 | 65,027 | 147,208 | 65,655 |
| Germany | 302,298 | 122,219 | 447,345 | 193,050 | (2) | (2) |
| Greece | 208,050 | 101,031 | 206,650 | 100,295 | (2) | (2) |
| Italy | 865,404 | 372,124 | 914,524 | 402,391 | 918,000 | (2) |
| Japan | 1,750,914 | 700,366 | (2) | (2) | (2) | (2) |
| Norway | 1,031,825 | 456,156 | 1,048,300 | 452,709 | 1,010,000 | (2) |
| Poland | 38,110 | 16,768 | 82,263 | 36,195 | 92,209 | 36,883 |
| Portugal | 237,728 | 112,921 | 604,132 | 283,986 | (2) | (2) |
| Rumania | 9,999 | 5,000 | 10,717 | 6,717 | (2) | (2) |
| Southern Rhodesia | 19,447 | 7,824 | 20,342 | 8,128 | 27,065 | (2) |
| Sweden | 134,206 | 57,014 | 172,968 | 75,337 | (2) | (2) |
| Union of South Africa | 24,533 | 11,154 | 28,915 | 12,931 | 31,017 | (2) |
| United Kingdom | 4,697 | (2) | 4,701 | (2) | (2) | (2) |
| United States | 556,019 | 220,068 | 593,542 | 235,520 | 564,547 | 222,612 |
| Uruguay | | | | | 70 | (2) |
| Yugoslavia | 79,754 | 35,889 | 133,985 | 60,253 | 150,402 | 67,681 |

[1] In addition to countries listed Belgium, China, Spain, and the U. S. S. R. produce pyrites, but production data are not available.
[2] Data not available.
[3] Exports.

*Canada.*—Of the Canadian pyrites output in 1938, 30,099 metric tons containing 15,041 tons of sulfur came from Quebec and 10,365 tons containing 5,259 tons of sulfur from British Columbia. Most of the shipments from Quebec came from the Eustis mine of the Consolidated Copper & Sulphur Co. near Sherbrooke. The Aldermac Copper Corporation, operator of the Aldermac mine in Beauchastel Township,

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made some shipments, but the bulk of its output of pyrites concentrates was stored awaiting the construction of a plant to manufacture elemental sulfur from pyrite. The output of British Columbia came from the Britannia mill, where pyrites concentrate is produced in the treatment of ores for the extraction of copper.

In addition, sulfuric acid is made from smelter gases at the Trail and Copper Cliff smelters, and elemental sulfur is made at Trail. In 1938, 81,663 metric tons of sulfur were recovered as sulfur or as sulfuric acid manufactured from smelter gases.

*Japan.*—Japan is one of the large producers of pyrites, but data on production in 1937 and 1938 are not available, owing to a ban on information pertaining to domestic production and consumption of pyrites. The entire output is consumed locally in the manufacture of sulfuric acid, and Japan is said to be self-sufficient as regards pyrites.

*Norway.*—Production of pyrites is the principal mining industry in Norway, and output exceeded 1,000,000 metric tons in 1938 for the third successive year. Exports were slightly lower in 1938, amounting to 654,955 tons compared with 676,535 tons in 1937. Some of the Norwegian pyrites is used locally for the production of elemental sulfur.

*Portugal.*—Production in Portugal was high in 1937 and 1938. Exports were 456,786 metric tons in 1938 compared with 652,750 tons in 1937.

*Spain.*—Spain is the principal world producer of pyrites, but war conditions undoubtedly affected operations during 1938. Data for recent years are not available.

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# PHOSPHATE ROCK

By Bertrand L. Johnson and K. G. Warner

## SUMMARY OUTLINE


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Export and domestic demand for American phosphate rock appears to have become stabilized. For the third time in three decades

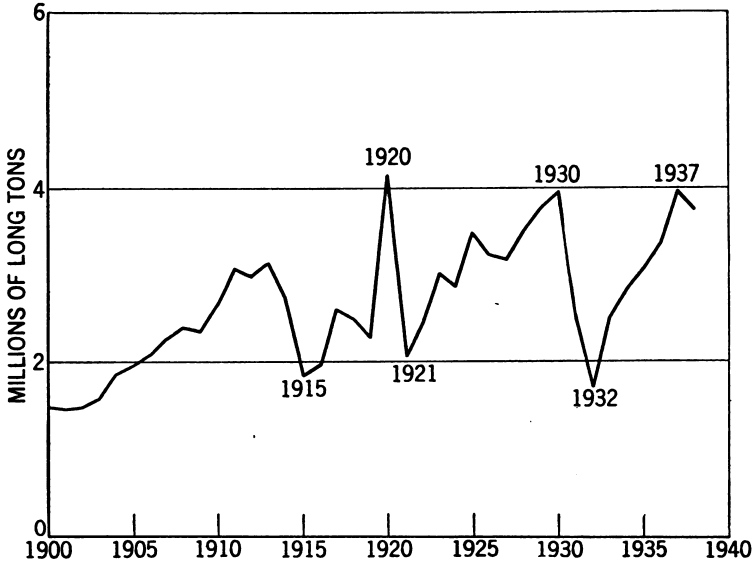


Figure 1.—Marketed production of United States phosphate rock, 1900–1938.

shipments from domestic mines fell from the 4-million-ton level into the broad horizontal trending zone within which they have fluctuated since the World War. (See fig. 1.) In 1938 exports were slightly greater than in 1937, but mine production, shipments, imports, and apparent consumption were all less than in 1937. Notwithstanding immense reserves, excess productive capacity, and adequate labor supply, general economic conditions have restricted domestic demand, and competition from superabundant foreign supplies has impeded further growth of export trade.



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*Salient statistics of the phosphate-rock industry in the United States, 1937–38*

| | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Long tons | Value at mines | | Long tons | Value at mines | |
| | | Total | Average | | Total | Average |
| Production (mined) | 4,261,416 | (1) | (1) | 3,860,476 | (1) | (1) |
| Sold or used by producers: | | | | | | |
| Florida: | | | | | | |
| Land pebble [2] | 2,872,413 | $8,600,512 | $2.99 | 2,528,808 | $7,993,665 | $3.16 |
| Soft rock | 60,256 | 200,271 | 3.32 | 53,479 | 178,093 | 3.33 |
| Hard rock | 64,151 | 342,202 | 5.33 | 125,048 | 601,922 | 4.81 |
| Total, Florida | 2,996,820 | 9,142,985 | 3.05 | 2,707,335 | 8,773,680 | 3.24 |
| Tennessee [2 3] | 825,099 | 3,343,108 | 4.05 | 899,298 | 3,725,601 | 4.14 |
| Idaho | 83,436 | 356,037 | 4.27 | 66,014 | 296,595 | 4.49 |
| Montana | 50,834 | 133,138 | 2.62 | 66,491 | 155,917 | 2.34 |
| South Carolina | | | | 100 | 350 | 3.50 |
| Virginia | (3) | (3) | (3) | (3) | (3) | (3) |
| Total, United States | 3,956,189 | 12,975,268 | 3.28 | 3,739,238 | 12,952,143 | 3.46 |
| Imports | 13,400 | [4] 115,926 | [4] 8.65 | 7,006 | [4] 80,539 | [4] 11.50 |
| Exports | 1,052,802 | [5] 5,818,231 | [5] 5.53 | 1,140,841 | [5] 6,637,638 | [5] 5.82 |
| Apparent consumption [6] | 2,916,787 | (1) | (1) | 2,605,403 | (1) | (1) |
| Stocks in producers' hands, Dec. 31: | | | | | | |
| Florida | 1,344,000 | (1) | (1) | 1,285,000 | (1) | (1) |
| Tennessee [3 7] | 236,000 | (1) | (1) | 224,000 | (1) | (1) |
| Other | 2,000 | (1) | (1) | 3,000 | (1) | (1) |
| Total stocks | 1,582,000 | (1) | (1) | 1,512,000 | (1) | (1) |

[1] Figures not available.
[2] Includes sintered matrix.
[3] Virginia included with Tennessee.
[4] Market value (or price) at port and time of exportation to the United States.
[5] Value at port of exportation.
[6] Quantity sold or used by producers plus imports minus exports.
[7] Includes brown-rock matrix of sinter grade and sintered brown rock.

On May 20, 1938, the President of the United States in a special message to Congress called attention to the heavy drain on the supposedly limited phosphate reserves of Tennessee and Florida, and recommended the appointment of a joint congressional committee to study the "entire subject of phosphate resources, their use and service to American agriculture." Senate Joint Resolution 298, approved June 16, 1938, authorized an investigation by such a joint committee of the House and Senate, headed by Senator Pope, of Idaho, and hearings were held at Washington, D. C.; Pocatello, Idaho; Knoxville, Tenn.; and Lakeland, Fla. A report [1] of this committee was presented to Congress in January 1939. On July 2, 1938, pending the results of the congressional investigation, Secretary of the Interior Harold L. Ickes ordered suspension of the granting of phosphate-mining leases on the public domain.

Phosphate rock, although essential to our national defense and necessary to the production of foodstuffs in war or peace, is not classed as either a strategic or critical mineral. Reserves in the United States are large, and production is potentially much greater than any anticipated need. The main producing area (Florida), however, lies within a few miles of the Atlantic coast, and many of the country's super-

[1] Joint Congressional Committee to Investigate the Adequacy and Use of the Phosphate Resources of the United States, 76th Cong., 1st sess., Report on the Phosphate Resources of the United States: S. Doc. 21, Washington, D. C., 1939, 11 pp.

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phosphate plants are in Atlantic coast cities, within easy reach of attack by sea.

The situation of the leading world powers with respect to phosphate rock is covered by McGrath and Jones [2] and Emeny.[3]

Several general papers on the phosphate-rock industry appeared during 1938.[4]

*Production.*—Mine production of phosphate rock in the United States was about 400,000 tons less in 1938 than in 1937. Output decreased markedly in Florida and slightly in the Western States but increased in Tennessee. Virginia again yielded apatite in nelsonite ores. Phosphate mining in South Carolina was resumed in 1938 on a small scale in the Coosaw River region.

*Phosphate rock mined in the United States, 1929–38, by States, in long tons*

| Year | Florida | Tennessee | Western States | United States | Year | Florida | Tennessee | Western States | United States |
|---|---|---|---|---|---|---|---|---|---|
| 1929 | 3,100,505 | 647,711 | 39,039 | 3,787,255 | 1934 | 2,464,969 | [1] 394,311 | 38,958 | 2,898,238 |
| 1930 | 3,361,786 | 607,814 | 66,597 | 4,036,197 | 1935 | 2,598,337 | [1] 493,501 | 67,490 | 3,159,328 |
| 1931 | 2,155,903 | 393,925 | 116,681 | 2,666,509 | 1936 | 2,645,819 | [1] 737,866 | 79,152 | 3,462,837 |
| 1932 | 1,500,891 | [1] 152,533 | 44,724 | 1,698,148 | 1937 | 3,179,588 | [1] 942,158 | 139,670 | 4,261,416 |
| 1933 | 2,039,531 | [1] 296,441 | 23,663 | 2,359,635 | 1938 | 2,722,927 | [2] 999,551 | 137,998 | 3,860,476 |

[1] Includes small quantity of apatite from Virginia.
[2] Includes small quantity of apatite from Virginia and phosphate rock from South Carolina.

*Sales.*—The quantity of domestic phosphate rock sold or used by producers in 1938 was 5 percent less than in 1937. However, it exceeded that in any other years except 1920, 1929, and 1930. (See fig. 1.) The total value of shipments in 1938 was less than 1 percent below 1937.

*Phosphate rock sold or used by producers in the United States, 1934–38*

| Year | Long tons | Value at mines | | Year | Long tons | Value at mines | |
|---|---|---|---|---|---|---|---|
| | | Total | Average | | | Total | Average |
| 1934 | 2,834,523 | $10,040,005 | $3.54 | 1937 | 3,956,189 | $12,975,268 | $3.28 |
| 1935 | 3,042,381 | 10,951,723 | 3.60 | 1938 | 3,739,238 | 12,952,143 | 3.46 |
| 1936 | 3,351,857 | 11,406,132 | 3.40 | | | | |

[1] McGrath, J. S., and Jones, L. M., World Production of Minerals and Economic Aspects of International Mineral Policies: Bureau of Mines, Minerals Yearbook 1935, pp. 19–25.
[2] Emeny, Brooks, The Strategy of Raw Materials: Macmillan Co., New York, 1934, 202 pp.
[3] Jacob, K. D., Phosphate Rock (in 1937): Mineral Ind., vol. 46, 1938, pp. 459–477.
Pit and Quarry, Gypsum, Phosphate, Feldspar Industries Make Important Gains: Vol. 30, No. 7, January 1938, pp. 74–76, 125.
Bowles, Oliver, Industrial Minerals, Outstanding Advances in Technology and Uses: Min. and Met., vol. 19, No. 373, January 1938, pp. 56–61.
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Brand, C. J., Our Phosphate Problem: Manufacturer's Record, vol. 107, No. 6, June 1938, pp. 20, 40.
Killefer, D. H., What's New in Phosphorus: Ind. and Eng. Chem., vol. 30, No. 9, September 1938, pp. 967–972.
Brand, C. J., Of Soils, and Crops and Men: Proc. 14th Ann. Convention Nat. Fertilizer Assoc., 1938, pp. 38–52.
Schreiner, Oswald, Merz, A. R., and Brown, B. E., Fertilizer Materials: Soils and Men, Yearbook of Agriculture, 1938, U. S. Dept. of Agriculture, pp. 487–521.
The Fertilizer Review (Special Phosphate Number): Vol. 13, No. 4, July–August 1938.
Tyler, Paul M., and Johnson, Bertrand L., The Phosphate Situation: Min. and Met., September 1938, pp. 389–393.
Johnson, Bertrand L., Potash and Phosphate Rock: Min. Cong. Jour., vol. 25, No. 2, February 1939, pp. 45–46.
Pit and Quarry, Gypsum, Phosphate, Feldspar, Other Groups Record Important Advances: Vol. 31, No. 7, January 1939, pp. 71–76, 79.

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*Distribution of sales.*—Sales of low-grade rock (below 60 percent B. P. L.) have increased steadily from 4 percent of the total sales in 1933 to 12 percent in 1938 (450,858 long tons). This trend results from the development of electrothermic smelting of low-grade phosphatic material, the re-treatment of land-pebble wastes by flotation, and the utilization of the low-grade, hard-rock, waste-pond phosphates. Most sales of phosphate rock however, remain of grades above 68 percent B. P. L.

The following table, showing distribution of sales by classes of consumers, is compiled from reports of domestic producers of phosphate rock.

Superphosphate manufacture is by far the largest outlet for domestically produced phosphate rock, although the manufacture of nonfertilizer phosphate chemicals has increased greatly.

*Phosphate rock sold or used by producers in the United States, 1937–38, by grades, uses, and classes of consumers*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Long tons | Value | Long tons | Value |
| Grades—B. P. L.[1] content (percent): | | | | |
| Below 60 | 319,584 | (2) | 450,858 | (2) |
| 60 to 66 | 6,517 | (2) | 100 | (2) |
| 68 basis, 66 minimum | 468,846 | (2) | 378,847 | (2) |
| 70 minimum | 408,105 | (2) | 387,501 | (2) |
| 72 minimum | 959,628 | (2) | 904,701 | (2) |
| 75 basis, 74 minimum | 1,039,383 | (2) | 914,664 | (2) |
| 75 minimum | | | | |
| 77 basis, 76 minimum | 330,949 | (2) | 327,951 | (2) |
| 77 minimum | | | | |
| Above 85 (apatite) | (3) | (2) | (3) | (2) |
| Undistributed [4] | 423,177 | (2) | 374,616 | (2) |
| | 3,956,189 | $12,975,268 | 3,739,238 | $12,952,143 |
| Uses: | | | | |
| Superphosphates | 2,391,245 | (2) | 2,074,779 | (2) |
| Phosphates, phosphoric acid, and ferrophosphorus | 492,805 | (2) | 443,086 | (2) |
| Direct application to soil | 85,133 | (2) | 83,069 | (2) |
| Fertilizer filler | 44,522 | (2) | 24,746 | (2) |
| Stock and poultry feed | 3,324 | (2) | 5,904 | (2) |
| Undistributed [5] | 939,160 | (2) | 1,107,654 | (2) |
| | 3,956,189 | 12,975,268 | 3,739,238 | 12,952,143 |
| Classes of consumers: | | | | |
| Affiliated companies | 967,395 | 2,994,554 | 959,717 | 3,182,569 |
| Other domestic consumers | 2,066,241 | 6,087,249 | 1,679,615 | 5,291,308 |
| Export [6] | 922,553 | 3,893,465 | 1,099,906 | 4,478,266 |
| | 3,956,189 | 12,975,268 | 3,739,238 | 12,952,143 |

[1] Bone phosphate of lime.
[2] Figures not available.
[3] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[4] Includes grades of B. P. L. content between 68 and 70; 71; between 73 and 74; 78/76; 78; and above 85 percent; also dust, B. P. L. content not known.
[5] Includes exports, some calcined phosphate, and phosphatic material used in pig-iron blast furnaces, in the manufacture of concentrated fertilizers, as filler in asphalt mixtures, and as foundry facings.
[6] As reported to the Bureau of Mines by producers (exclusive of exports by dealers, etc.).

*Consumption.*—The apparent domestic consumption of phosphate rock in 1938 (2,605,403 tons) was about 300,000 tons less than that in 1937. A diagram on page 1171 of Minerals Yearbook 1938 shows the calculated extension of the logistic curve fitted to the domestic consumption of phosphate rock. The actual figures for 1938 tend to confirm the decreasing rate of increase and sidewise trend in domestic consumption forecasted by the logistic curve.

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*Prices.*—Domestic quotations in the trade journals for the various grades of phosphate rock were unchanged throughout 1938, but in January 1939 a slight increase was reported in the price of the 68-percent B. P. L. grade of land pebble ($1.85 to $1.90) and larger decreases were reported in the prices for the higher grades. The 70-percent B. P. L. grade decreased from $2.35 to $2.15, the 72-percent grade from $2.85 to $2.40, and the 75-percent grade from $3.85 to $2.90. Such quotations, however, have been purely nominal in recent years, most actual sales having been made under contract.

*Reserves.*—Improved methods are making it possible to mine hitherto inaccessible deposits of phosphate rock and to utilize lower-grade deposits and waste dumps that could not have been worked profitably under old conditions. Previous estimates of reserves on higher-grade rock [5] were inadequate, and new estimates were needed. The new estimates, prepared in 1938 by the phosphate-mining industry, have been tabulated and discussed by Waggaman,[6] consulting engineer for the Phosphate Rock Institute, and his table comparing the old with the new estimates of reserves follows.

*Old and new estimates of phosphate reserves in selected States, by kind of rock*

[Thousands of long tons]

| State and kind of phosphate rock | Old estimates [1] | | New estimates [2] | |
|---|---|---|---|---|
| | Phosphate rock, basis 70 percent B. P. L. | Equivalent elemental P | Phosphate rock, basis 35–70 percent B. P. L. | Equivalent elemental P |
| Western States (Idaho, Montana, Utah, and Wyoming): | | | | |
| Rock containing— | | | | |
| 70 percent B. P. L. | 6,569,259 | 919,696 | 6,569,259 | 919,696 |
| 55 percent B. P. L. | | | [3] 13,138,519 | 1,445,237 |
| Total western reserves | 6,569,259 | 919,696 | 19,707,778 | 2,364,933 |
| Tennessee: | | | | |
| Brown rock | 18,131 | 2,538 | [4] 106,000 | 11,660 |
| Blue rock (70 percent B. P. L.) | 83,233 | 11,653 | 86,000 | 12,040 |
| White rock | | | [4] 23,000 | 2,530 |
| Phosphatic limestone | | | [5] 5,300,000 | 477,000 |
| Total Tennessee reserves | 101,364 | 14,191 | 5,515,000 | 503,230 |
| Florida: | | | | |
| Hard rock | 7,686 | 1,076 | [4] 2,000,000 | 220,000 |
| Pebble | 544,566 | 76,239 | [4] 3,000,000 | 330,000 |
| Soft rock | | | [4] 1,000,000 | 110,000 |
| Bedrock (35 percent B. P. L.) | | | [6] 20,000,000 | 1,400,000 |
| Total Florida reserves | 552,252 | 77,315 | 26,000,000 | 2,060,000 |
| Grand total | 7,222,875 | 1,011,202 | 51,222,778 | 4,928,163 |

[1] Jacob, K. D., Phosphate Rock Reserves of the United States: Commercial Fertilizer Yearbook, 1938, pp. 28–43, 55, 59.
[2] Estimates made for Joint Congressional Committee Investigating Phosphate Reserves of the United States (November 1938).
[3] According to G. R. Mansfield; previous estimates of western reserves can be multiplied by 3 if lower-grade rock is considered.
[4] 55 percent B. P. L. and better.
[5] 45 percent B. P. L. and better.
[6] 35 percent B. P. L.

[5] Jacob, K. D., The Phosphate Rock Reserves of the United States: Commercial Fertilizer Handbook, 1938, pp. 28–43, 55, 59.
[6] Waggaman, W. H., Our Phosphate Reserves: Chem. and Met. Eng., vol. 46, No. 2, February 1939, pp. 66–68.

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The old estimate was based on phosphate rock averaging approximately 70 percent B. P. L., because only rock of this grade or better was considered suitable for the manufacture of superphosphate. The new estimate is based on material containing as low as 45 percent B. P. L. or capable of being beneficiated to this concentration and used in electric furnaces to produce elemental phosphorus. This estimate also includes as possible reserves huge quantities of phosphatic limestone in Tennessee and the phosphatic bedrock (Hawthorne formation) of the Florida land-pebble field. At present neither is used as a source of phosphorus, but small quantities of the former are used as chicken grit. Even if these low-grade formations are excluded, however, the new estimate is three to four times as large as the previous estimate in terms of phosphate rock and three times as large in terms of elemental phosphorus. If they are included, the present estimate is over seven times the older tonnage figures and is five times as large in terms of elemental phosphorus. The new estimates indicate a supply sufficient at the present rate of consumption for over 10,000 years and in Florida alone for 4,000 years.

Maynard [7] has discussed the preparation of these new reserve figures.

## REVIEW BY STATES

### FLORIDA

Although phosphate-rock production in Florida in 1938 was considerably less than in 1937, this State easily retained its leading position, producing three times as much as its nearest competitor, Tennessee. Both the quantity and value of the land-pebble and soft-rock shipments decreased, but shipments and value of hard rock increased. Producers of land pebble and hard rock in 1938 were the same as in the 2 previous years. (See Minerals Yearbook 1937, pp. 1318 and 1319.) Sintered phosphate matrix was made by the Pembroke Chemical Co., Pembroke, Fla., and shipped to Europe for further processing. Production of elemental phosphorus in Florida was begun in January 1938 at the only electric-furnace plant for that purpose in Florida—that of the Phosphate Mining Co. at Nichols, Fla.

Seven large companies operated in the land-pebble field. Three of these (International Agricultural Corporation, American Agricultural Chemical Co., and Amalgamated Phosphate Co.) contributed 61 percent of the total shipments in 1938. In the hard-rock field only three companies operated. The limited output of soft rock was made by several small concerns.

Billions of tons of phosphate rock that can be processed economically by present technologic methods are now believed to occur in Florida, where hitherto only a few hundred million tons had been estimated. New estimates, made by the phosphate-rock industry, quintuple the former estimates of land-pebble reserves, increase those of hard rock over 200 times, and add a billion tons for soft phosphate. The extensive but inadequately prospected Tertiary Hawthorne formation underlying the land-pebble field, which is known to carry high-grade phosphate rock in several spots, is also included in the estimates as a possible source of 20 billion tons of phosphate rock,

[7] Maynard, Poole, New Data on Our Phosphate Reserves: Chem. Ind., vol. 44, No. 1, January 1939, pp. 26–27.

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making the estimated total reserves of Florida phosphate rock containing over 35 percent B. P. L. equal to 26 billion tons.

The results of Government prospecting on certain public phosphate lands in Florida were given in a press release [8] late in 1938.

Trends in the technology, employment, and output per man in the phosphate-rock industry in Florida since 1880 are covered in a recent report by A. Porter Haskell, Jr., and O. E. Kiessling.[9] The new phosphate plant of Swift & Co. was described by Trauffer.[10]

*Florida phosphate rock sold or used by producers, 1934–38*

| Year | Hard rock | | | Soft rock [1] | | |
|---|---|---|---|---|---|---|
| | Long tons | Value at mines | | Long tons | Value at mines | |
| | | Total | Average | | Total | Average |
| 1934 | 91,134 | $523,783 | $5.75 | 28,896 | $86,447 | $2.99 |
| 1935 | 116,483 | 500,526 | 4.30 | 36,430 | 125,129 | 3.43 |
| 1936 | 138,859 | 579,202 | 4.17 | 31,769 | 103,352 | 3.25 |
| 1937 | 64,151 | 342,202 | 5.33 | 60,256 | 200,271 | 3.32 |
| 1938 | 125,048 | 601,922 | 4.81 | 53,479 | 178,093 | 3.33 |

| Year | Land pebble | | | Total | | |
|---|---|---|---|---|---|---|
| | Long tons | Value at mines | | Long tons | Value at mines | |
| | | Total | Average | | Total | Average |
| 1934 | 2,249,304 | $7,466,087 | $3.32 | 2,369,334 | $8,076,317 | $3.41 |
| 1935 | 2,269,891 | 7,751,954 | 3.42 | 2,422,804 | 8,377,609 | 3.46 |
| 1936 | 2,454,272 | 7,845,969 | 3.20 | 2,624,900 | 8,528,523 | 3.25 |
| 1937 | [2] 2,872,413 | [2] 8,600,512 | 2.99 | [2] 2,996,820 | [2] 9,142,985 | 3.05 |
| 1938 | [2] 2,528,808 | [2] 7,993,665 | 3.16 | [2] 2,707,335 | [2] 8,773,680 | 3.24 |

[1] Includes material from waste-pond operations.
[2] Includes sintered matrix.

## SOUTH CAROLINA

After many years South Carolina again has become a producing State. In 1938, 100 tons of phosphate rock were mined and exported from the Coosaw River region by the General Phosphate Corporation.

As a result of recent technologic improvements in the manufacture of phosphoric acid and elemental phosphorus, phosphate rock of even lower average grade than that formerly produced in South Carolina is now utilized in both Florida and Tennessee, and the joint congressional investigating committee's report suggests that "the Nation's lesser deposits [of phosphate rock], such as those in Arkansas and South Carolina, should be developed and conserved in the principal interest of the areas immediately surrounding them."

The history of the phosphate-rock industry of South Carolina has recently been covered in an unpublished report by Helen F. Mappus.[11]

[8] United States Department of the Interior, Government Explores Public Phosphate Lands in Florida, Results of Geological Survey Investigations: Memorandum for the Press, November 16, 1938, 3 pp.
[9] Haskell, A. Porter, Jr., and Kiessling, O. E., Technology, Employment, and Output Per Man in Phosphate-Rock Mining, 1880–1937: W. P. A., Nat. Research Project, in cooperation with U. S. Department of Interior, Bureau of Mines, Rept. E-7, Philadelphia, November 1938, 130 pp.
[10] Trauffer, W. E., New Phosphate Plant of Swift & Co.: Pit and Quarry, vol. 31, No. 6, December 1938, pp. 32–36, 40.
[11] Mappus, Helen F., The Phosphate Industry of South Carolina: Master's Thesis, Univ. South Carolina, 1935, 92 pp.

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## TENNESSEE

Tennessee again established a new record in phosphate-rock production in 1938, the quantity and value of its shipments being greater than ever before. Brown rock was shipped from Maury, Giles, Davidson, and Williamson Counties. No blue or white rock was mined or shipped during the year. Total stocks of phosphate rock in producers' hands in Tennessee at the close of 1938 were somewhat lower than at the end of 1937.

*Tennessee phosphate rock sold or used by producers, 1934–38*

[Includes apatite from Virginia]

| Year | Long tons | Value at mines | | Year | Long tons | Value at mines | |
|---|---|---|---|---|---|---|---|
| | | Total | Average | | | Total | Average |
| 1934 [1] | 425,952 | $1,815,678 | $4.26 | 1937 [1 2] | 825,099 | $3,343,108 | $4.05 |
| 1935 [1] | 550,284 | 2,323,536 | 4.22 | 1938 [2] | 899,298 | 3,725,601 | 4.14 |
| 1936 [1] | 643,822 | 2,598,279 | 4.04 | | | | |

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.
[2] Includes sintered matrix.

In each year since 1935, six phosphate-rock mining companies (Armour Fertilizer Works, Charleston Mining Co., Federal Chemical Co., Hoover & Mason Phosphate Co., International Agricultural Corporation, and the Monsanto Chemical Co.) have, together with the Tennessee Valley Authority, produced 98 percent or more of the total annual production of Tennessee. In 1938 these seven producers contributed over 99 percent of the total for the State. The three leading producers—Charleston Mining Co., International Agricultural Corporation, and Monsanto Chemical Co.—furnished 63 percent of the State total in 1938.

Reports describing recent developments in the Tennessee phosphate-rock industry,[12] the Hoover & Mason plant,[13] and the technology, employment, and output per man in the Tennessee phosphate-rock industry, 1880–1937,[14] have been published lately.

The Victor Chemical Works completed the construction of its electric-furnace plant for the production of elemental phosphorus at Mount Pleasant, Tenn., and began operations June 1, 1938, the material for the furnace being furnished by the Charleston Mining Co.

Tonnage production of elemental phosphorus by the electric-furnace plant of the Monsanto Chemical Co., near Columbia, Tenn., has made available such quantities of pure dry phosphorus pentoxide that the price in carload lots was cut 33⅓ percent in 1938, or from 18 to 12 cents a pound.

Increasing quantities of low-grade phosphatic materials are being mined in Tennessee largely for use in the electric-furnace production of elemental phosphorus. In 1938, 39 percent of the total production of the State was brown rock or matrix containing less than 60 percent B. P. L. The Charleston Mining Co., Monsanto Chemical Co., and

[12] Tyler, P. M., and Mosley, H. R., Recent Developments in the Tennessee Phosphate-Rock Industry: Am. Inst. Min. and Met. Eng. Tech. Pub. 1053, February 1939, 22 pp.
[13] Rock Products, Modern Tennessee Phosphate Plant Solves Problem of Recovery of Fines: Vol. 41, No. 8, August 1938, pp. 34–38.
[14] See footnote 9.

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the Tennessee Valley Authority produced this low-grade material for electric-furnace uses and the Harsh Phosphate Co. for fertilizer fillers.

New estimates [15] of the phosphate-rock reserves in Tennessee, made by the phosphate-rock industry, place the quantity at 5 to 6 billion tons of phosphate rock containing over 45 percent B. P. L. The new estimate of reserves of brown, blue, and white phosphate rock combined is only double the previous estimate of about 100 million tons, the increase being due to the inclusion of figures for white rock and much enlarged figures for brown rock. The big increase in the new estimate of total reserves, however, is due to the inclusion of more than 5 billion tons for the at present unworked phosphatic limestones of the Central Basin of Tennessee, now believed amenable to present-day flotation or calcination treatment to produce products suitable for furnace processes or acidulation. These limestones were not included in the previous estimate, as at that time they were not considered of commercial value.

Mining operations of the Tennessee Valley Authority were in progress in 1938 both on its own and leased lands in the brown-rock field. According to its annual report, the T. V. A. at the end of the fiscal year 1937–38 held phosphate leases on 11 properties totaling 1,999 acres in Maury, Sumner, and Perry Counties and owned fee simple title to or mineral rights in 1,825 acres in tracts in Maury and Williamson Counties. Some of the matrix mined for T. V. A. during 1938 was exchanged for sintered phosphate rock produced by the Monsanto Chemical Co., which was shipped together with the remainder of the rock mined and rock purchased to the Muscle Shoals (Ala.) plant of the T. V. A.

T. V. A. continued research on the production of concentrated phosphate fertilizers. A small commercial-size unit manufacturing calcium metaphosphate was operated successfully, and 4,246 tons of calcium metaphosphate were manufactured during the fiscal year, production at the end of that period being at the rate of 30 tons a day. During the year a third electric furnace of approximately the same capacity as each of the other two was put into operation, and a new phosphoric acid plant was completed and successfully operated. The furnaces produced phosphorus for the metaphos unit and phosphoric acid for 45,759 tons of concentrated superphosphate containing about 43 to 46 percent $P_2O_5$.

Several articles were published in 1938 covering T. V. A. phosphate operations.[16]

A report of the findings of an interdepartmental committee appointed by the Secretaries of Agriculture and Interior in response to a request of the Joint Congressional Committee on the Investigation of the Tennessee Valley Authority was released November 9, 1938. This report contained the results of a scientific survey and technical investigation of the phosphate purchases of the T. V. A.

[15] Waggaman, W. H., Our Phosphate Reserves: Chem. and Met. Eng., vol. 46, No. 2, February 1939, pp. 66–68.
Maynard, Poole, New Data on our Phosphate Reserves: Chem. Ind., vol. 44, No. 1, January 1939, pp. 26–27.

[16] Curtis, H. A., Miller, A. M., and Newton, R. H., Process Developments at T. V. A. Phosphoric Acid Plant: Chem. and Met. Eng., vol. 45, No. 4, April 1938, pp. 193–197.
Curtis, H. A., Copson, R. L., Abrams, A. J., and Junkins, J. N., Full Scale Production of Metaphosphate Achieved at Wilson Dam: Chem. and Met. Eng., vol. 45, No. 6, June 1938, pp. 318–322.
Newton, R. H., T. V. A.'s Phosphate Smelting Results: Chem. and Met. Eng., vol. 45, No. 7, July 1938, pp. 374–379.

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### VIRGINIA

The Southern Mineral Products Corporation (a subsidiary of the Vanadium Corporation of America) operated its milling plant at Piney River, Nelson County, Va., and recovered apatite concentrates from nelsonite ore from its mines in Amherst County, Va. The quantity of apatite concentrates recovered, sales, and stocks on hand at the end of the year increased in 1938 over 1937.

### WESTERN STATES

In 1938 Idaho and Montana were the only phosphate-rock-producing States in the West. In Idaho there was only one producing company in 1938, as in recent years—the Anaconda Copper Mining Co., which operated its No. 3 mine at Conda, Caribou County. In Montana there were two producers—one large and one small. The Montana Phosphate Products Co., Trail, British Columbia, operated the Anderson mine near Garrison, Powell County, and United States Government Leases 076740 and 081920, supplying the requirements of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail. Some of the product from these operations was ground by William Anderson at the mill near Garrison for direct application to the soil. The Mineral Hill Mining Co. (Cronin and Crowley) in 1938 made a relatively small output from its mine near Avon, shipping its product to the Anaconda Copper Mining Co. fertilizer plant at Anaconda, Mont.

The mine at Cokeville, Wyo., was not operated in 1938, but in 1937 a carload of phosphate rock was taken from this mine and shipped to the T. V. A. plant at Wilson Dam, Ala., for experimental work.

Most western phosphate rock is processed chemically at the plant of the Anaconda Copper Mining Co. at Anaconda, Mont., and that of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, British Columbia. Both plants treat the phosphate rock with sulfuric acid, producing "triple" (or "treble") superphosphate. The plant at Trail, because of its synthetic ammonia operations, also makes ammonium phosphate and mixtures of ammonium phosphate and ammonium sulfate. A considerable part of the Canadian product comes back to American farms and citrus growers in the Western States.

Phosphate rock from Idaho is also used for the production of phosphate chemicals, in pig-iron blast-furnace charges, for the preparation of ordinary superphosphate in California, and for direct application to the soil.

A few articles regarding the deposits and operations of the Western States were published during the year.[17]

The Joint Congressional Committee to Investigate the Adequacy and Use of the Phosphate Resources of the United States [18] recommended that—

[17] Curtis, H. A., Western Phosphate Deposits: Ind. and Eng. Chem., vol. 30, No. 9, September 1938, pp. 973–979.
Waggaman, W. H., Our Phosphate Reserves: Chem. and Met. Eng., vol. 46, No. 2, February 1939, pp. 66–68.
Chemical and Metallurgical Engineering, What About Western Phosphates: Vol. 45, No. 9, September 1938, pp. 486–487.
Pike, R. D. [Potash-Phosphate Fertilizer from Western Rock]: Chem. and Met. Eng., vol. 46, No. 2, February 1939, p. 86.
Hubbard, J. S., Lower Mining Costs: Chem. and Met. Eng., vol. 46, No. 2, February 1939, p. 86.

[18] See footnote 1.

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A plant for experimental, educational, and demonstration purposes be established in the vicinity of the vast western deposits of phosphate, in order that those resources which are mainly located on public lands be conserved and wisely used for the benefit of American agriculture. Until such plant can be established, we recommend that the Tennessee Valley Authority conduct experiments with western phosphate ores, with particular reference to combination of potash and phosphate fertilizer products suitable for western soils.

*Western States phosphate rock sold or used by producers, 1934–38*

| Year | Idaho | | | Montana | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Long tons | Value at mines | | Long tons | Value at mines | | Long tons | Value at mines | |
| | | Total | Average | | Total | Average | | Total | Average |
| 1934 | 37,151 | $140,397 | $3.78 | 2,086 | $7,613 | $3.65 | 39,237 | $148,010 | $3.77 |
| 1935 | 41,796 | 176,877 | 4.23 | 27,497 | 73,701 | 2.68 | 69,293 | 250,578 | 3.62 |
| 1936 | 47,113 | 203,264 | 4.31 | 36,022 | 76,066 | 2.11 | 83,135 | 279,330 | 3.36 |
| 1937 | 83,436 | 356,037 | 4.27 | 50,834 | 133,138 | 2.62 | 134,270 | 489,175 | 3.64 |
| 1938 | 66,014 | 296,595 | 4.49 | 66,491 | 155,917 | 2.34 | 132,505 | 452,512 | 3.42 |

## FOREIGN TRADE[19]

*Imports.*—Imports of phosphate rock into the United States in 1938 were limited to 2 long tons of apatite from Brazil and 7,004 tons of phosphate rock, mostly from French Oceania (6,300 tons) and Netherland West Indies (Curaçao) (701 tons). Three tons came from British Malaya.

Curaçao phosphate rock is outstanding because of its low fluorine content (less than 1 percent). Jacob and others[20] state that—

In proportion to the phosphoric acid content, Curaçao phosphate contains less fluorine than any of the other calcium phosphate rocks for which data are available.

*Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1934–38*

| Fertilizer | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value |
| Apatite | ------ | -------- | 3,599 | $28,829 | 3,100 | $17,187 | ------- | ---------- | 2 | $5 |
| Phosphate rock, crude | ------ | -------- | 100 | 900 | ------ | -------- | (1) | (1) | (1) | (1) |
| Ammonium phosphates, used as fertilizer | 9,955 | $390,023 | 10,812 | 401,431 | 13,383 | 475,483 | 27,253 | $1,089,657 | 29,028 | 1,286,935 |
| Bone dust, or animal carbon, and bone ash, fit only for fertilizing | 15,948 | 308,873 | 18,388 | 354,900 | 23,215 | 465,585 | 37,341 | 857,349 | 19,581 | 393,808 |
| Guano | 16,638 | 337,136 | 16,219 | 311,645 | 22,804 | 457,209 | 13,104 | 375,650 | 15,199 | 717,817 |
| Slag, basic, ground or unground | 131 | 2,009 | 1,078 | 15,136 | 758 | 9,758 | 714 | 7,339 | 691 | 9,547 |
| Precipitated bone, fertilizer grade | ------ | -------- | 472 | 11,613 | 3,817 | 96,166 | 4,414 | 120,225 | 3,385 | 98,725 |
| Phosphates, crude, not elsewhere specified | (2) | (2) | (2) | (2) | (2) | (2) | 13,400 | 115,926 | 7,004 | 80,534 |

[1] Not shown separately; included with "Phosphates, crude, not elsewhere specified" beginning Jan. 1, 1937.
[2] New classification beginning Jan. 1, 1937.

[19] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[20] Jacob, K. D., Hill, W. L., Marshall, H. L., and Reynolds, D. S., The Composition and Distribution of Phosphate Rock, with Special Reference to the United States: U. S. Dept. Agriculture Tech. Bull. 364, June 1933, p. 39.

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*Exports.*—Exports in 1938 were a little over a million tons and slightly exceeded 1937, both in quantity and value. The average value per ton of exports of phosphate rock increased from $5.53 in 1937 to $5.82 in 1938. The phosphate rock exported in 1938 came from Florida, South Carolina, and the Western States. Figure 2

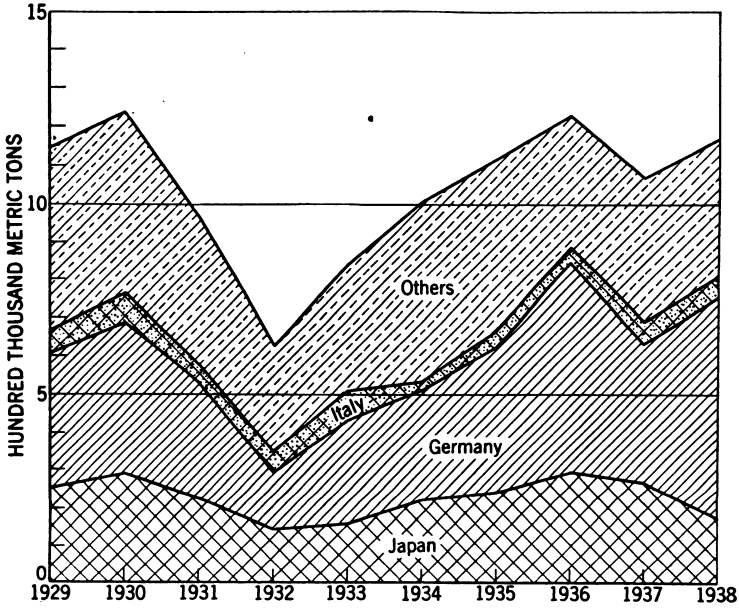


FIGURE 2.—Exports of phosphate rock from United States to Germany, Japan, Italy, and other countries, 1929–38.

shows the trends in total phosphate exports and in exports to the two largest importers of domestic phosphate—Germany and Japan—as well as to Italy.

*Phosphate rock exported from the United States, 1934–38*

| Year | Long tons | Value | | Year | Long tons | Value | |
|---|---|---|---|---|---|---|---|
| | | Total | Average | | | Total | Average |
| 1934 | 993,493 | $5,008,532 | $5.04 | 1937 | 1,052,802 | $5,818,231 | $5.53 |
| 1935 | 1,104,394 | 5,773,506 | 5.23 | 1938 | 1,140,841 | 6,637,638 | 5.82 |
| 1936 | 1,208,951 | 6,776,917 | 5.61 | | | | |

The quantity and value of exports of both hard rock and land pebble increased in 1938 over 1937. The quantity and value of exports of other phosphatic materials, principally sintered phosphate matrix, were less. The following tables show total exports of high-grade hard rock and land-pebble phosphate rock, as well as shipments of each type of rock to various countries from 1934 to 1938, inclusive.

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*Phosphate rock exported from the United States, 1934–38, by countries*

HIGH-GRADE HARD ROCK

| Country | 1934 | | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value |
| Australia | 2,133 | $16,471 | | | | | | | | |
| Belgium | 5,325 | 37,275 | | | 4,300 | $30,100 | 4,250 | $29,750 | 4,000 | $28,000 |
| British Malaya | | | | | | | | | 507 | 5,000 |
| British West Indies ("Other") | | | 2 | $40 | | | | | | |
| Canada | 823 | 8,628 | 28,907 | 121,686 | 39,271 | 274,934 | 49,970 | 305,865 | 67,134 | 406,463 |
| Germany | 38,100 | 266,700 | 49,880 | 349,160 | 72,400 | 507,950 | 31,457 | 216,016 | 57,250 | 369,787 |
| Italy | | | | | | | | | 3,000 | 18,750 |
| Japan | | | | | | | 1 | 11 | | |
| Lithuania | 7,000 | 49,000 | 6,000 | 42,000 | | | 12,150 | 85,050 | | |
| Netherlands | 14,600 | 102,200 | 19,575 | 137,025 | 15,050 | 115,350 | 1,800 | 12,600 | 14,450 | 94,420 |
| Panama | 1 | 31 | 4 | 31 | | | 50 | 812 | 4 | 48 |
| Poland and Danzig | | | | | 7,700 | 53,900 | | | 2,900 | 18,125 |
| Sweden | 29,630 | 192,595 | 25,700 | 169,075 | 25,225 | 174,350 | 20,800 | 145,600 | 32,675 | 219,425 |
| | 97,612 | 672,900 | 130,068 | 819,017 | 163,946 | 1,156,584 | 120,478 | 795,704 | 181,920 | 1,160,018 |

LAND PEBBLE

| Country | 1934 | | 1935 | | 1936 | | 1937 [1] | | 1938 [1] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value |
| Austria | | | 3,000 | $15,750 | 3,001 | $15,005 | 7,397 | $42,308 | 5,781 | $32,301 |
| Belgium | 4,986 | $30,804 | 3,293 | 16,794 | 77,972 | 478,384 | 88,050 | 546,730 | 96,073 | 588,299 |
| British West Indies ("Other") | 5 | 99 | | | | | | | | |
| Canada | 28,650 | 164,939 | 29,562 | 160,028 | 37,853 | 165,166 | 60,174 | 267,983 | 59,275 | 250,465 |
| Czechoslovakia | | | | | 5,983 | 30,114 | 29,494 | 185,867 | 26,238 | 155,987 |
| Denmark | 32,013 | 143,817 | 36,186 | 159,242 | | | 7,331 | 34,404 | 7,495 | 33,503 |
| Finland | 3,500 | 14,875 | | | | | | | | |
| France | 3,006 | 15,480 | 3,671 | 20,374 | | | | | | |
| Germany | 143,882 | 740,458 | 211,179 | 1,157,410 | 278,404 | 1,660,508 | 189,603 | 1,104,534 | 358,077 | 2,181,869 |
| Hungary | | | | | 4,852 | 24,163 | 26,266 | 135,330 | 10,017 | 69,107 |
| Italy | 106,760 | 571,107 | 60,643 | 359,123 | 65,813 | 393,657 | 69,012 | 426,094 | 49,911 | 305,718 |
| Japan | 213,620 | 880,824 | 222,110 | 952,974 | 281,797 | 1,176,953 | 278,155 | 1,153,910 | 159,270 | 664,392 |
| Mexico | | | | | | | | | 39 | 200 |
| Netherlands | 158,629 | 792,600 | 147,769 | 812,060 | 142,432 | 904,135 | 98,850 | 628,370 | 103,666 | 675,249 |
| Norway | | | 1,499 | 11,243 | | | | | | |
| Poland and Danzig | 34,994 | 219,081 | 28,499 | 176,781 | 16,654 | 93,428 | 17,586 | 115,975 | 2,993 | 19,821 |
| Rumania | | | 11,298 | 56,490 | 12,852 | 64,260 | | | | |
| Spain | 89,226 | 412,799 | 140,329 | 668,454 | 28,720 | 151,789 | | | | |
| Sweden | 41,645 | 188,532 | 29,738 | 165,491 | 45,664 | 291,870 | 48,608 | 306,412 | 66,113 | 412,948 |
| Switzerland | | | | | | | 4,814 | 37,068 | 6,620 | 46,316 |
| United Kingdom | 22,693 | 97,419 | 28,659 | 126,776 | 43,008 | 170,901 | 5,488 | 28,940 | 7,353 | 41,445 |
| Yugoslavia | 12,272 | 62,798 | 16,891 | 95,499 | | | 1,496 | 8,602 | | |
| | 895,881 | 4,335,632 | 974,326 | 4,954,489 | 1,045,005 | 5,620,333 | 932,324 | 5,022,527 | 958,921 | 5,477,620 |

[1] Excludes sintered matrix.

*Other phosphate materials[1] exported from the United States, 1934–38*

| Year | Long tons | Value | Year | Long tons | Value |
|---|---|---|---|---|---|
| 1934 | 6,153 | $218,499 | 1937 [2] | 55,665 | $466,850 |
| 1935 | 3,984 | 154,429 | 1938 [2] | 33,074 | 283,668 |
| 1936 | 3,489 | 165,385 | | | |

[1] Includes bone ash, dust, and meal; animal carbon for fertilizer; basic slag; etc.
[2] Includes sintered matrix.

The following table shows exports of high-grade hard rock from the different customs districts. In 1938 most rock of this type went from the hard-rock district in Florida to Europe, but a large quantity of high-grade hard rock was shipped from the Montana-Idaho district to Canada.

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*High-grade hard-rock phosphate exported from the United States, 1937–38, by customs districts*

| Customs district | 1937 | | 1938 | |
|---|---|---|---|---|
| | Long tons | Value | Long tons | Value |
| Buffalo | 324 | $3,625 | 2 | $30 |
| Dakota | 2 | 19 | 14 | 120 |
| Florida | 70,457 | 489,016 | 114,782 | 753,507 |
| Los Angeles | 1 | 9 | | |
| Michigan | 150 | 1,404 | 70 | 812 |
| Montana and Idaho | 49,491 | 300,786 | 67,042 | 405,445 |
| New Orleans | | | 4 | 48 |
| New York | 50 | 812 | | |
| St. Lawrence | 3 | 31 | 2 | 16 |
| Washington | (1) | 2 | 4 | 40 |
| | 120,478 | 795,704 | 181,920 | 1,160,018 |

[1] Less than 1 ton.

## WORLD PRODUCTION

World production of phosphate rock from 1934 to 1938, inclusive, is shown in the following table. Statistical details of world trade, production, and consumption of phosphate rock for 1935, 1936, and 1937 were published early in 1939.[21]

*World production of phosphate rock, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Algeria | 532,210 | 603,863 | 530,998 | 631,148 | 584,440 |
| Angaur Island [1] | 72,148 | 70,468 | 50,803 | (2) | (2) |
| Australia: New South Wales | 210 | 239 | 178 | 20 | (2) |
| Belgium | 14,385 | 173,360 | 16,090 | | (2) |
| Canada | 73 | 169 | 476 | 91 | 189 |
| China [3] | 8,000 | 8,000 | 8,000 | 8,000 | 8,000 |
| Christmas Island (Straits Settlements) [4] | 129,780 | 149,341 | 157,564 | 154,378 | 162,425 |
| Egypt | 437,933 | 473,896 | 531,031 | 517,002 | (2) |
| Estonia | 10,610 | 11,642 | 11,408 | 10,112 | (2) |
| France | 66,800 | 49,600 | 55,000 | 103,600 | (2) |
| Germany | 735 | 180 | 1,060 | 3,314 | (2) |
| Austria | | 440 | 120 | | (2) |
| India, British | 60 | 104 | 130 | 169 | (2) |
| Indochina | 4,600 | 5,888 | 10,336 | 20,252 | (2) |
| Italy | | 500 | | 200 | (2) |
| Japan | 56,500 | 91,248 | 113,102 | (2) | (2) |
| Madagascar | 8,340 | 6,000 | 5,349 | 4,290 | (2) |
| Makatea Island [4] | 77,470 | 130,353 | 122,936 | 166,726 | 102,941 |
| Morocco, French [5] | 1,266,796 | 1,303,182 | 1,257,796 | 1,501,767 | 1,447,544 |
| Nauru and Ocean Islands [6] | 565,522 | 707,051 | 965,349 | 1,024,168 | 1,158,907 |
| Netherland India | 5,013 | 11,553 | 12,072 | 26,167 | (2) |
| Netherland West Indies: Curaçao [4] | 100,627 | 90,709 | 78,131 | 101,837 | (2) |
| New Caledonia | 2,000 | 11,855 | 2,254 | (2) | (2) |
| Philippine Islands | 20,406 | 1,309 | 497 | | (2) |
| Poland | 7,655 | 11,641 | 12,497 | (2) | (2) |
| Rumania | 1,219 | 2,784 | 1,039 | (2) | (2) |
| Seychelles Islands [4] | 12,062 | 10,082 | 23,942 | 9,594 | (2) |
| Spain | 19,297 | (2) | (2) | (2) | (2) |
| Taiwan | | 91 | 213 | (2) | (2) |
| Tanganyika Territory | 208 | 194 | | 104 | (2) |
| Tunisia | 1,766,000 | 1,500,000 | 1,488,000 | 1,771,439 | 1,934,200 |
| Union of South Africa | 77 | | | | |
| U. S. S. R. [7] | 382,800 | 767,900 | 920,000 | (2) | (2) |
| United States (sold or used by producers) | 2,880,017 | 3,091,211 | 3,405,654 | 4,019,686 | 3,799,253 |

[1] Exports during fiscal year ended Mar. 31 of year following that stated.
[2] Data not available.
[3] Estimated (Imp. Inst., London).
[4] Exports.
[5] Shipments, including exports as follows: 1934, 1,255,847 tons; 1935, 1,296,052 tons; 1936, 1,247,923 tons; 1937, 1,484,562 tons; 1938, 1,427,643 tons.
[6] Exports during fiscal year ended June 30 of year stated.
[7] Apatite concentrates. Production of apatite ore in 1936 amounted to 2,000,000 tons. In addition low-grade phosphate rock is produced, but production data are not available.

[21] Gray, A. N., Statistics of Phosphate Rock and Superphosphate for 1937: Superphosphate (London), vol. 12, No. 1, January 1939, pp. 2–7.

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## INTERNATIONAL TRADE

Statistics on trade among the various countries producing or consuming phosphate rock in 1938 are shown in a table issued by the Phosphate Export Association (New York). Diagrams embodying some of the data are included in this chapter because of the current interest in the future of Tunisia. These diagrams show destinations of exports of phosphate rock from Tunisia (fig. 3), sources of French

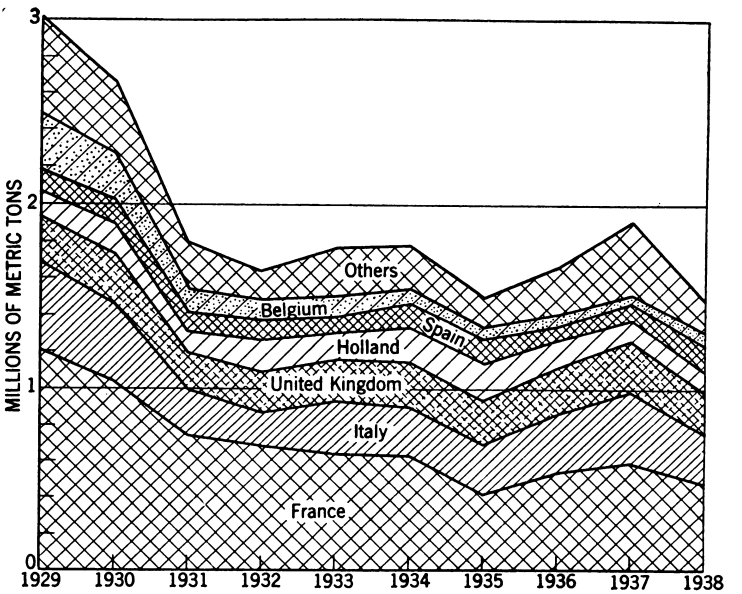


FIGURE 3.—Destinations of exports of phosphate rock from Tunisia, 1929–38.

phosphate-rock supplies (fig. 4), and sources of Italian phosphate-rock supplies (fig. 5).

## TECHNOLOGY

The reactions of calcined phosphate rock (obtained by heating silica-bearing phosphate rock at 1,400° C. in the presence of water) with ammonium sulfate and superphosphate are described in a paper by Beeson and Jacob.[22]

Results of a study of the treatment of phosphate rock with by-product hydrochloric acid for the production of monocalcium chlorophosphate, a potential fertilizer material, is given in a paper by Fox and Clark.[23]

Many data on the technology of the domestic phosphate-rock industry are contained in a report by Haskell and Kiessling.[24] Articles in recent issues of the Fertilizer Review [25] also contain data on the technology of phosphate rock.

[22] Beeson, K. C., and Jacob, K. D., Chemical Reactions in Fertilizer Mixtures. Reactions of Calcined Phosphate with Ammonium Sulfate and Superphosphate: Ind. and Eng. Chem., vol. 30, No. 3, March 1938, pp. 304–308.

[23] Fox, E. J., and Clark, K. G., Monocalcium Chlorophosphate. Reaction Product of Calcium Chloride and Phosphoric Acid: Ind. and Eng. Chem., vol. 30, No. 6, June 1938, pp. 701–703.

[24] See footnote 9.

[25] The Fertilizer Review, Progress in the Mining and Processing of Phosphate Rock: Vol. 13, No. 4, July-August 1938, pp. 12–13; Phosphorus, Superphosphate, and Other Phosphorus Compounds, Vol. 14, No. 1, January-February 1939, pp. 8–10.

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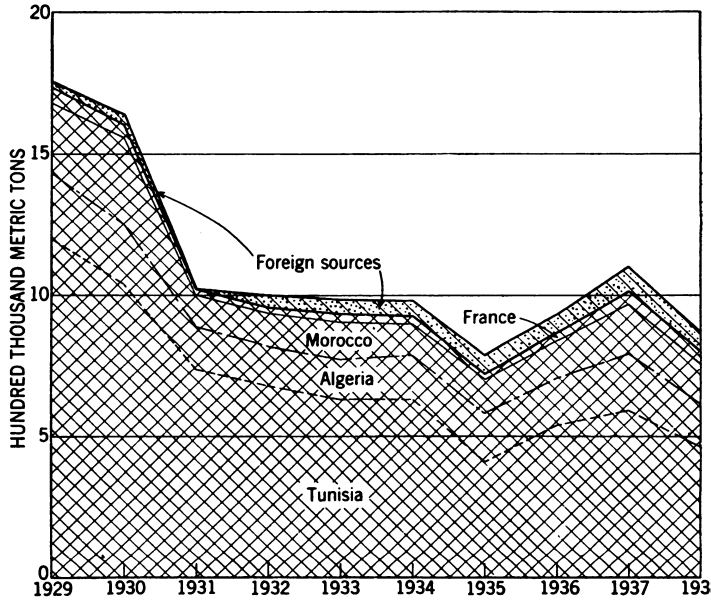


FIGURE 4.—Sources of French phosphate-rock supplies, showing relation of supplies from France and its possessions to total supplies, 1929–38.

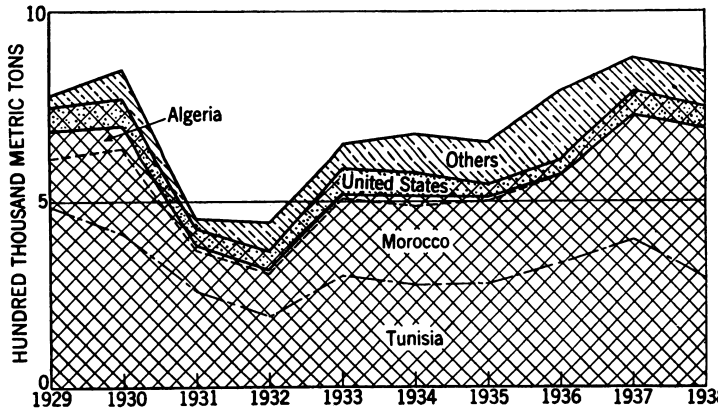


FIGURE 5.—Sources of Italian supplies of phosphate rock, showing relation of imports from French possessions to total imports, 1929–38.

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## SUPERPHOSPHATES

The following table shows the salient features of the superphosphate industry in the United States, 1935–38.

*Summary of statistics for superphosphate industry in the United States, 1935–38*

| | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| Production: [1] | | | | |
| Bulk superphosphate, short tons | 2,954,130 | 3,412,486 | 4,429,767 | 3,575,588 |
| Base and mixed goods, do | 109,609 | 142,459 | 122,680 | 156,730 |
| Shipments: [1] | | | | |
| Bulk superphosphates, to consumers, do | 824,177 | 997,011 | 1,046,334 | 902,490 |
| Bulk superphosphates, to others, do | 1,223,132 | 1,672,049 | 2,130,860 | 1,817,293 |
| Base and mixed goods, do | 1,354,728 | 1,480,719 | 1,723,590 | 1,537,491 |
| Stocks in manufacturers' hands, Dec. 31: [1] | | | | |
| Bulk superphosphates, do | 1,217,767 | 1,133,640 | 1,313,327 | 1,361,127 |
| Base and mixed goods, do | 619,909 | 657,828 | 784,532 | 669,503 |
| Exports of superphosphates [2], long tons | 54,965 | 68,368 | 78,949 | 90,237 |
| Imports of superphosphates [2], do | 20,543 | 18,395 | 57,930 | 18,753 |
| Sales of phosphate rock by producers for superphosphate production, long tons | 1,690,554 | 1,768,677 | 2,391,245 | 2,074,779 |

[1] Bureau of the Census, Monthly Statistics Superphosphate Industry; 16 percent available phosphoric acid.
[2] Bureau of Foreign and Domestic Commerce.

The following table shows the source of imports of superphosphates and the destination of exports of domestic superphosphates for 1937 and 1938.

*Superphosphates (acid phosphates) imported into and exported from the United States, 1937–38, by countries*

| Country | Imports | | | | Exports | | | |
|---|---|---|---|---|---|---|---|---|
| | 1937 | | 1938 | | 1937 | | 1938 | |
| | Long tons | Value | Long tons | Value | Long tons | Value | Long tons | Value |
| Argentina | | | | | | | 500 | $16,070 |
| Belgium | 3,316 | $180,422 | 2,540 | $77,198 | | | | |
| Canada | 17,514 | 279,184 | 7,333 | 125,426 | 57,038 | $620,636 | 73,649 | 770,677 |
| Chile | | | | | | | 240 | 2,235 |
| Cuba | | | | | 17,487 | 175,632 | 12,282 | 102,822 |
| Dominican Republic | | | | | 43 | 1,959 | 32 | 1,173 |
| France | 136 | 6,300 | | | | | | |
| Jamaica | | | | | 46 | 915 | | |
| Japan | 4,449 | 78,213 | | | | | | |
| Mexico | | | | | 65 | 2,390 | 186 | 9,946 |
| Netherlands | 32,515 | 440,141 | 8,880 | 121,769 | | | | |
| Philippine Islands | | | | | | | 246 | 3,575 |
| Salvador | | | | | 142 | 5,381 | | |
| Turkey | | | | | 1,375 | 10,999 | | |
| Union of South Africa | | | | | | | 2,955 | 34,296 |
| United Kingdom | | | | | 2,582 | 20,530 | | |
| Venezuela | | | | | | | 52 | 2,280 |
| West Indies "Other British" | | | | | 120 | 1,692 | 60 | 826 |
| Other countries | | | | | 51 | 928 | 35 | 1,451 |
| | 57,930 | 984,260 | 18,753 | 324,393 | 78,949 | 841,062 | 90,237 | 945,351 |

Statistics for 1936, covering international trade in superphosphate and production of superphosphate in various countries, were published early in 1938.[26] Several articles dealing with the technology and economics of the superphosphate industry appear in the Fertilizer Review, vol. 14, No. 1, January-February 1939.

[26] Gray, A. N., Phosphate and Superphosphate Statistics for the Year 1936; II, Superphosphate: Superphosphate (London), vol. 11, No. 2, 1938, pp. 21–27.



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## BASIC SLAG

Shortly after the introduction of the basic Bessemer process in 1878 for converting pig iron into steel and simultaneously removing the phosphorus, the slag produced in the process was used as a liming material for acid and lime-deficient soils. Later the effectiveness of the phosphorus in the slag was recognized, and basic slag is now an important competitor of phosphate rock and superphosphate as a source of fertilizer phosphorus in various European countries. Basic slag contains 5 to 20 percent available phosphoric acid, and that produced in this country is sold on the basis of a content of 8 percent total phosphoric acid.[27] The domestic market is limited and is satisfied by the importation of a small quantity and by an annual production of a few thousand tons in the Birmingham iron district of Alabama.

*Production of basic slag in Europe and the United States, 1934–37, in metric tons* [1]

| Country | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|
| Europe: | | | | |
| Belgium [5] | 660,000 | 569,000 | 605,000 | 825,000 |
| Czechoslovakia | 94,000 | 125,000 | 145,000 | 163,000 |
| Eire | 700 | | 2,000 | 2,000 |
| France: | | | | |
| Saar | 323,000 | (3) | (3) | (3) |
| Other districts | 879,000 | 940,000 | 1,035,000 | 1,218,000 |
| Germany | 1,358,000 | [3] 2,025,000 | [3] 2,277,000 | [3] 2,370,000 |
| Italy | | 2,000 | 1,000 | 1,000 |
| Luxemburg | 409,000 | 396,000 | 431,000 | 533,000 |
| Poland | | 1,000 | (4) | 4,000 |
| Sweden | 13,000 | 15,000 | 16,000 | 15,000 |
| U. S. S. R. | 29,000 | 41,000 | (4) | (4) |
| United Kingdom [5] | 266,000 | 276,000 | 302,000 | 410,000 |
| | 4,031,700 | 4,390,000 | [6] 4,814,000 | [7] 5,541,000 |
| North America: United States [5] | 25,000 | 25,000 | 36,000 | 36,000 |
| | 4,056,700 | 4,415,000 | [6] 4,850,000 | [7] 5,577,000 |

[1] Adapted from figures as published by Imperial Institute, London.
[2] Estimated.
[3] Production of Saar included with Germany.
[4] Data not available.
[5] Estimated amount ground and used as fertilizers.
[6] Exclusive of Poland and U. S. S. R.
[7] Exclusive of U. S. S. R.

[27] Schreiner, Oswald, Merz, A. R., and Brown, B. E., Fertilizer Materials: U. S. Dept. Agriculture Yearbook, 1938, Soils and Men, pp. 487–521. (See pp. 501, 502, and 512.)

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# TALC, PYROPHYLLITE, AND GROUND SOAPSTONE[1]

By BERTRAND L. JOHNSON and K. G. WARNER

## SUMMARY OUTLINE


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Reacting slightly from the all-time peak year of 1937, sales of talc, pyrophyllite, and ground soapstone in 1938 declined 17,000 tons. Total sales of 212,775 short tons valued at $2,302,560 compared favorably with the levels of recent years. Sales of ground materials decreased 20,000 tons, but this decrease was partly counterbalanced by increases in sales of crude and sawed and manufactured materials. Imports of crude materials were a little larger than in 1937, but those of manufactured products were considerably less. Exports of crude and ground talc, steatite, and soapstone decreased, but exports of talcum powders increased slightly.

Pyrophyllite is included in this discussion with talc solely because the custom was established many years ago in these annual reports of the Bureau of Mines. Although pyrophyllite resembles talc in certain physical properties, it is a hydrous aluminum silicate ($Al_2Si_4O_{10}(OH)_2$) instead of a hydrous magnesium silicate like talc ($Mg_3Si_4O_{10}(OH)_2$). Dana [2] and other mineralogists place pyrophyllite in a kaolin division containing the kaolin minerals—kaolinite, dickite, and nacrite—and the hydrous aluminum silicates—halloysite, allophane, beidellite, and montmorillonite. Schwartz [3] places it in a trivalent hydrous metadisilicate group with kaolin, montmorillonite, and certain other minerals. Pyrophyllite has a somewhat different composition and structure [4] from kaolinite ($Al_2Si_2O_5(OH)_4$).

[1] Soapstone sold in slabs or blocks is included in the chapter on Stone.

[2] Dana, E. S., Textbook of Mineralogy: 4th ed., revised and enlarged by W. E. Ford, New York, John Wiley & Sons, 1932, pp. 639–640, 680–684.

[3] Schwartz, C. K., Classification of the Natural Silicates: Am. Mineral., vol. 22, No. 11, 1937, pp. 1073–1087; No. 12, 1937, pp. 1161–1174.

[4] Bragg, W. L., The Atomic Structure of Minerals: Cornell Univ. Press, Ithaca, N. Y., 1937, 292 pp.



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*Salient statistics of the talc, pyrophyllite, and ground-soapstone industry in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Sales by producers: | | | | |
| Crude | 11,087 | $52,750 | 13,498 | $72,845 |
| Sawed and manufactured | 1,101 | 111,680 | 1,729 | [1] 70,268 |
| Ground | 217,811 | 2,397,323 | 197,548 | 2,159,447 |
| | 229,999 | 2,561,753 | 212,775 | 2,302,560 |
| Imports for consumption: | | | | |
| Crude and unground steatite and French chalk | 324 | 7,644 | 337 | 5,956 |
| Manufactures (except toilet preparations) wholly or partly finished | 26,552 | 465,175 | 21,790 | 385,242 |
| | 26,876 | 472,819 | 22,127 | 391,198 |
| Exports: | | | | |
| Talc, steatite, and soapstone, crude and ground | 8,878 | 149,625 | 7,118 | 124,194 |
| Powders—talcum (in packages), face, and compact | (2) | 966,473 | (2) | 978,100 |
| | | 1,116,098 | | 1,102,294 |

[1] Includes crude value of some sawed material. [2] Quantity not recorded.

Nine States produced talc, pyrophyllite, and ground soapstone in 1938. Two of these States were on the Pacific coast; the others, producing most of the output, were in the East. Both talc and soapstone were produced in California, Maryland, Vermont, and Virginia; talc only in Georgia, New York, and Washington; talc and pyrophyllite in North Carolina; and only soapstone in Pennsylvania.

## SALES

Sales of talc, pyrophyllite, and ground soapstone, which totaled 212,775 short tons in 1938, were down from the peak of 1937 to the general zone of fluctuations that has marked the upper limit of sales during recent years. Decreases in total sales of more than 7 percent in quantity and 10 percent in value from 1937 reflected the decreased demand for ground talc. Sales of crude, as well as sawed and manufactured materials, increased.

*Talc, pyrophyllite, and ground soapstone, sold by producers in the United States, 1934–38, by classes*

| Year | Crude | | Sawed and manufactured | | Ground | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 8,767 | $55,659 | 174 | $46,918 | 129,564 | $1,346,108 | 138,505 | $1,448,685 |
| 1935 | 10,725 | 57,259 | 841 | 63,211 | 161,150 | 1,727,585 | 172,716 | 1,848,055 |
| 1936 | 10,910 | 59,556 | 618 | 90,542 | 204,663 | 2,193,073 | 216,191 | 2,343,171 |
| 1937 | 11,087 | 52,750 | 1,101 | 111,680 | 217,811 | 2,397,323 | 229,999 | 2,561,753 |
| 1938 | 13,498 | 72,845 | 1,729 | [1] 70,268 | 197,548 | 2,159,447 | 212,775 | 2,302,560 |

[1] Includes crude value of some sawed material.

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*Sales by States.*—Decreased sales in 1938 were reported by all the larger talc-producing States except Georgia, which has made a new high record every year since 1932 and in 1938 increased its sales 26 percent over the 1937 figure. Increases were also achieved in Mary-

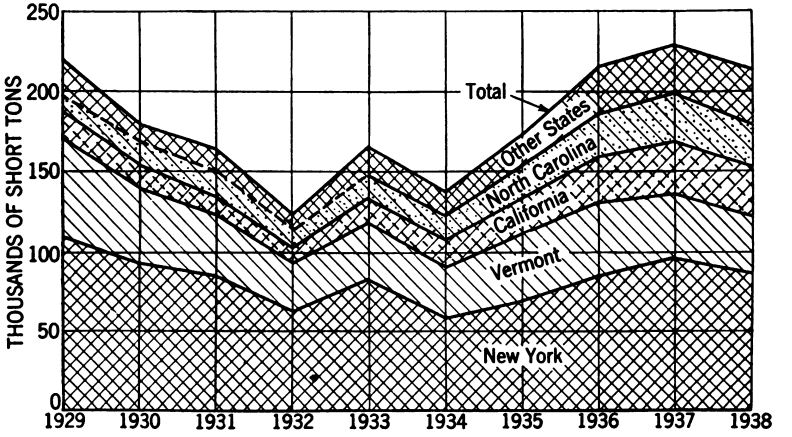


FIGURE 1.—Production of talc, pyrophyllite, and ground soapstone in the United States, 1929–38, by States.

land and Pennsylvania. Sales in both California and North Carolina dropped from the all-time highs of 1937.

*Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1937–38, by States*

| State | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| California | 32,495 | $427,031 | 30,059 | $391,456 |
| Georgia | 11,984 | 148,177 | 15,117 | 130,595 |
| New York | 96,140 | 1,215,834 | 86,423 | 1,110,024 |
| North Carolina | 28,250 | 271,013 | 27,460 | 241,337 |
| Vermont | 41,118 | 384,474 | 35,126 | 329,084 |
| Washington | 406 | 6,754 | 174 | 894 |
| Other States [1] | 19,606 | 108,470 | 18,416 | 99,170 |
| | 229,999 | 2,561,753 | 212,775 | 2,302,560 |

[1] Maryland, Pennsylvania, and Virginia.

## MARKETS [5]

The domestic market for talc, pyrophyllite, and ground soapstone is the largest in the world. It not only consumes most of the large domestic production of the crude material but also absorbs the hundreds of tons of foreign talc imported each year. In 1933, a depression year, domestic industries took 162,315 short tons of talc, pyrophyllite, and ground soapstone, principally of domestic origin, and in 1937, during a period of comparative prosperity, they required 221,445 tons. The market takes most of these materials in the ground state, 98 percent of the domestic sales of talc being ground material. Less than 1 percent is in the form of sawed and manufac-

[5] *See also* Johnson, Bertrand L., Marketing Talc, Pyrophyllite, and Ground Soapstone: Bureau of Mines Inf. Circ. 7080, June 1939, 13 pp.

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tured material and the rest is crude. The largest markets for industrial-grade talcs are in the northeastern quarter of the United States and along the Pacific coast. Markets exist in many industries, principally, however, in the paint, ceramics, roofing, paper, and rubber industries, which in 1938 bought 77 percent of the total sales of domestic materials. Figure 2 shows the demand in the leading markets for the past 3 years.

Although consumption in the paint, paper, rubber, and several other industries declined in 1938, sales to the roofing industry increased 17 percent, and sales for toilet preparations—a minor outlet for domestic talc—jumped 38 percent. Paint manufacture is still the principal consumer, but the relative importance of other outlets has

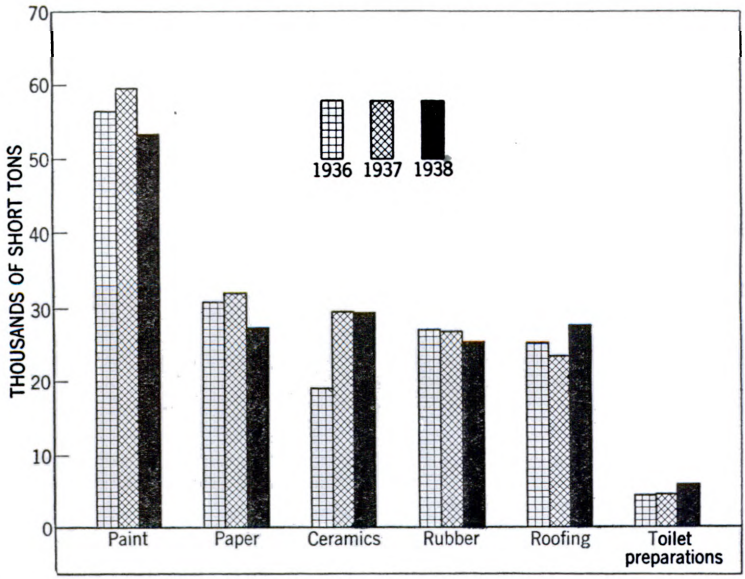


FIGURE 2.—Consumption of talc, pyrophyllite, and ground soapstone by leading consuming industries in the United States, 1936-38.

altered greatly. The ceramic industry, which took virtually the same quantity in 1938 as in 1937, is now in second place. Owing to an imposing gain, roofing climbed to third place, whereas it ranked fifth in 1937. Paper, formerly second, dropped to fourth position and rubber to fifth.

New York is the leading supplier of talc to the paint, ceramic, and paper industries, North Carolina to the rubber industry, and Vermont to the roofing industry. Pennsylvania led in supplying the needs for toilet preparations and Virginia in supplying those for foundry facings.

Almost 90 percent of the domestic talc used in paint in 1938 came from mines in New York; only minor quantities were shipped from other States, principally Pennsylvania, Vermont, California, and Maryland. New York's share of ceramic-talc sales was 48 and California's 30 percent; the remainder was chiefly pyrophyllite from North Carolina, although talc from Maryland, Vermont, and Washington also was used in ceramics. Vermont supplied about one-half of the talc used in roofing, the remainder coming from Georgia,

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Virginia, Maryland, North Carolina, and Washington, in the order named. More than two-thirds of the talc taken by the paper industry came from New York and almost all the remainder from Vermont. Rubber manufacturers are large users of North Carolina pyrophyllite but also use substantial quantities of talc from Vermont, Georgia, and New York. Imported talc dominates the toilet-preparations industry, but Pennsylvania, California, and North Carolina shared in the increased sales of domestic raw material to this high-priced market in 1938.

*Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1937–38, by uses*

| Use | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Percent of total | Short tons | Percent of total |
| Paint | 59,660 | 26 | 53,506 | 25 |
| Ceramics | 29,793 | 13 | 29,590 | 14 |
| Roofing | 23,551 | 10 | 27,607 | 13 |
| Paper | 32,127 | 14 | 27,329 | 13 |
| Rubber | 26,941 | 12 | 25,374 | 12 |
| Toilet preparations | 4,340 | 2 | 5,970 | 3 |
| Foundry facings | 3,228 | 1 | 2,511 | 1 |
| Other uses [1] | 28,265 | 12 | 20,732 | 10 |
| Use not reported | 22,094 | 10 | 20,156 | 9 |
| | 229,999 | 100 | 212,775 | 100 |

[1] Includes crayons, bleaching, insecticides, plaster, textile, and other minor uses.

## PRICES

Talc is a relatively low priced commodity. The average value per ton of all grades of talc, pyrophyllite, and ground soapstone, f. o. b. mills, in the last few years, as reported to the Bureau of Mines by producers, has ranged from $10.43 to $12.50 a short ton. In 1938 it was $10.82. Lava-grade talcs and talcs suitable for making crayons bring the highest prices, generally $100 to $150 a ton. Prices for other kinds of domestic talc, pyrophyllite, and ground soapstone are much lower. Domestic ground talcs, except toilet grades, normally range in price from $4 to $20 a ton. Much domestic roofing talc (20- to 50-mesh) is said to have been sold as low as $4 a ton. Quotations on finer-ground domestic talcs, f. o. b. works, carload lots, were about as follows in 1938: Virginia talc, 200-mesh, $4.75 to $5.50, 325-mesh, $6.25 to $7; Georgia talc, 200-mesh, $6, 300-mesh, $7.50 to $10; Vermont talc, 200-mesh, $8 to $14; New York talc, 325-mesh, $11 to $17; California talc, $17 to $20. Ground soapstone from Virginia is generally quoted at $5 to $7 a ton, and that from Vermont at $10 to $12. Ground-pyrophyllite quotations range from $7.50 to $12 a ton. Prices of imported talcs range from $20 or less to $85 a ton, the higher prices being for Italian and French talcs.

*Average value per short ton of talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1934–38*

| | | | |
|---|---|---|---|
| 1934 | $10.46 | 1937 | $11.14 |
| 1935 | 10.70 | 1938 | 10.82 |
| 1936 | 10.84 | | |

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## DEVELOPMENTS IN THE INDUSTRY

Recent plant developments in the pyrophyllite industry include the putting into operation in November 1937 [6] of the new plant of the Carolina Pyrophyllite Co. at Capyco, near Staley, N. C., and reported improvements at the plant of Standard Minerals, Inc., at Hemp, N. C.

The Carolina Pyrophyllite Co. obtains pyrophyllite from its mine, the Gerhardt deposit on Soapstone Mountain, about 4 miles west of the Capyco plant. The mine is operated as a glory hole with a shaft through which the material drops to a haulage tunnel. Trucks carry the pyrophyllite from the mine to the plant, where it is fed to a jaw crusher; the product is ground in Hardinge conical mills, after which it passes to Gayco air separators which can be set to produce any size of material from 60- to 325-mesh.

Inasmuch as the physical properties of pyrophyllite resemble those of ground talc, its early application was as a substitute for ground talc in many industries. In recent years, however, various percentages of pyrophyllite have been used as a ceramic-body ingredient in wall tile, in tableware, and as an addition in electrical porcelains. Stevens [7] has described its use as an electrical insulator and reports as follows:

> Pyrophyllite bodies compare favorably with porcelain in mechanical and electrical characteristics and may be used in applications where high puncture values or zero porosity are not prerequisites. Pyrophyllite is superior to porcelain in high-frequency applications, but it is inferior to steatite.

Parmelee and Barrett [8] have tested the pyrochemical properties of samples of North Carolina and Austrian pyrophyllite. Lintz [9] has discussed the use of talc and pyrophyllite in vitreous and semivitreous dinnerware bodies and concludes that a semivitreous dinnerware body can be developed by use of talc and pyrophyllite with a small percentage of whiting, the body having good drying and firing properties, high mechanical strength, and improved resistance to delayed crazing.

The use of pyrophyllite and talc as mineral fillers was discussed during the year in an article by Maynard.[10]

Investigations of the use of talc as a ceramic material still continue. Two papers by Thurnauer [11] discuss its use as a raw material for the manufacture of high-frequency insulators. In another paper Thurnauer [12] discusses the properties of cordierite-containing ceramic bodies with low thermal expansion, resulting from the firing of talc-kaolin mixtures.

## FOREIGN TRADE [13]

*Imports.*—Both the quantity and value of total imports of talc, steatite or soapstone, and French chalk declined in 1938. The quantity was less than in any year since 1934, and the value was less than

[6] Trauffer, W. E., Pyrophyllite Mining Undergoes Revival: Pit and Quarry, vol. 31, No. 10, April 1939, pp. 42–43.

[7] Stevens, Frank J. (engineering vice president, American Lava Corporation), Notes on the Use of Pyrophyllite as an Electrical Insulator: Jour. Am. Ceram. Soc., vol. 21, No. 9, September 1938, pp. 330–331.

[8] Parmelee, C. W., and Barrett, L. R., Some Pyrochemical Properties of Pyrophyllite: Jour. Am. Ceram. Soc., vol. 21, No. 11, November 1938, pp. 388–393.

[9] Lintz, E. H., The Use of Talc and Pyrophyllite in Semivitreous Dinnerware Bodies: Jour. Am. Ceram. Soc., vol. 21, No. 6, June 1938, pp. 229–237.

[10] Maynard, Poole, The Fillers—Clay, Talc, etc., 1918–38: Chem. Ind., vol. 43, No. 6., November 1938, pp. 491–495.

[11] Thurnauer, Hans (engineer, American Lava Corporation), Notes on Steatite-type, High-frequency Insulation: QST, November 1937, 2 pp.; Review of Ceramic Materials for High-frequency Insulation: Jour. Amer. Ceram. Soc., vol. 20, No. 11, November 1937, pp. 368–372.

[12] Thurnauer, Hans (engineer, American Lava Corporation), Cordierite Gives Low Expansion in Ceramic Bodies: Ceram. Ind., November 1937, 2 pp.

[13] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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any year since the bottom of the depression in 1932. Declines were noted in imports from nearly all countries. Italy was again the leading source of supply, with Canada second and France third. Several tons of pyrophyllite were imported in 1938 from Manuels, Conception Bay, Newfoundland. In 1904 and 1905 a total of 7,750 tons were shipped from this deposit to the United States.

*Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1934–38*

| Year | Crude and unground steatite and French chalk | | Manufactures (except toilet preparations) wholly or partly finished | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 204 | $4,729 | 20,245 | $421,640 | 20,449 | $426,369 |
| 1935 | 298 | 5,856 | 23,598 | 486,418 | 23,896 | 492,274 |
| 1936 | 188 | 2,915 | 24,332 | 453,752 | 24,520 | 456,667 |
| 1937 | 324 | 7,644 | 26,552 | 465,175 | 26,876 | 472,819 |
| 1938 | 337 | 5,956 | 21,790 | 385,242 | 22,127 | 391,198 |

*Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Argentina | (1) | $15 | | |
| Austria | 1 | 69 | [2] 1 | [2] $69 |
| Belgium | | | 1 | 60 |
| Canada | 7,221 | 72,388 | 6,438 | 65,968 |
| China | 2,460 | 55,357 | 1,767 | 42,479 |
| Egypt | 92 | 1,653 | 55 | 1,039 |
| France | 6,372 | 102,592 | 4,244 | 64,693 |
| Germany | 76 | 898 | | |
| Hong Kong | 2 | 456 | 2 | 306 |
| India, British | 224 | 3,365 | 287 | 4,514 |
| Italy | 8,653 | 208,488 | 7,842 | 192,146 |
| Japan | 1,364 | 21,622 | 1,325 | 16,915 |
| Kwantung | 51 | 396 | 34 | 330 |
| Norway | 246 | 2,623 | 131 | 2,647 |
| Sweden | | | (1) | 26 |
| Union of South Africa | 26 | 625 | | |
| United Kingdom | 88 | 2,272 | (1) | 6 |
| | 26,876 | 472,819 | 22,127 | 391,198 |

[1] Less than 1 ton.
[2] Figures cover period Jan. 1 to May 5.

*Exports.*—Both the quantity and value of exports of "talc, steatite, and soapstone, crude and ground," were less in 1938 than in 1937, a reversal of the upward trend from 1933 to 1937, but the value of exports of "powders—talcum (in packages), face, and compact" was slightly greater than in 1937, continuing the upward trend started in 1934 for this type of material.

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*Talcum and other powders exported from the United States, 1934–38*

| Year | Description | Short tons | Value |
|---|---|---|---|
| 1934 | Talc, crude, in bulk | 4,903 | $83,530 |
| | Powders—talcum (in packages), face, and compact | (1) | 598,404 |
| 1935 | Talc, crude, in bulk | 5,814 | 101,290 |
| | Powders—talcum (in packages), face, and compact | (1) | 711,383 |
| 1936 | Talc, steatite, and soapstone, crude and ground | 6,670 | 115,434 |
| | Powders—talcum (in packages), face, and compact | (1) | 803,571 |
| 1937 | Talc, steatite, and soapstone, crude and ground | 8,878 | 149,625 |
| | Powders—talcum (in packages), face, and compact | (1) | 966,473 |
| 1938 | Talc, steatite, and soapstone, crude and ground | 7,118 | 124,194 |
| | Powders—talcum (in packages), face, and compact | (1) | 978,100 |

[1] Quantity not recorded.

## WORLD PRODUCTION

In 1938, as in previous years, the United States was the leading talc-producing country of the world, its production far exceeding that of other important producing countries, such as Canada in North America, China, and British India in Asia, and Austria, France, Germany, Italy, and Norway in Europe.

*World production of talc and soapstone, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country[1] | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Argentina | | 176 | 177 | (2) | (2) |
| Australia: | | | | | |
| New South Wales | 341 | 511 | 520 | 526 | (2) |
| South Australia | 1,419 | 954 | 1,003 | 991 | (2) |
| Tasmania | 6 | | 3 | | (2) |
| Bulgaria | 15 | 15 | | | (2) |
| Canada[3] | 12,663 | 12,522 | 13,161 | 11,301 | 9,846 |
| China (including Manchuria) | 68,000 | (2) | (2) | (2) | (2) |
| Egypt | 2,603 | 366 | 351 | 2,266 | (2) |
| Finland | 1,586 | 2,185 | 1,683 | 881 | (2) |
| France | 68,900 | 59,500 | 51,550 | 56,300 | (2) |
| Germany: | | | | | |
| Austria (exports) | 20,673 | 20,951 | 19,975 | 14,089 | 5,625 |
| Bavaria | 6,934 | 7,163 | 9,589 | 7,790 | (2) |
| Greece | 118 | 552 | 864 | 1,838 | (2) |
| India, British | 9,525 | 12,798 | 10,128 | 13,249 | (2) |
| Indochina | | | 630 | 428 | (2) |
| Italy | 37,640 | 41,692 | 43,938 | 45,714 | (2) |
| Morocco, French (exports) | 788 | 720 | 1,368 | 841 | (2) |
| Norway | 27,723 | 27,782 | 29,714 | 24,701 | (2) |
| Rumania | 1,933 | 1,999 | 2,529 | 1,976 | (2) |
| Spain | 5,285 | (2) | (2) | (2) | (2) |
| Sweden | 6,501 | 6,063 | 7,146 | 7,937 | (2) |
| Union of South Africa (Transvaal) | 239 | 303 | 413 | 376 | 1,519 |
| United States[4] | 125,649 | 156,685 | 196,124 | 208,650 | 193,025 |
| Uruguay (exports) | 879 | 1,200 | 772 | 302 | 1,615 |

[1] In addition to the countries listed talc is produced in Brazil, Newfoundland, and the U. S. S. R., but data of production are not available.
[2] Data not available.
[3] Excludes soapstone, which is reported only by value and was as follows: 1934, $44,297; 1935, $32,053; 1936, $32,770; 1937, $40,513; 1938, $35,038. Soapstone is sold in the form of both blocks and powder.
[4] Talc, pyrophyllite, and ground soapstone sold or used by producers.

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# FLUORSPAR AND CRYOLITE

By H. W. Davis and M. E. Trought

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## FLUORSPAR

The year 1938, in vivid contrast to the statistical record for 1937, was one of sharply reduced demand for fluorspar. Consequently, production schedules at most domestic mines were suspended or curtailed, and imports declined substantially. Compared with 1937, consumption of fluorspar in 1938 decreased 41 percent, production 46 percent, shipments from domestic mines 56 percent, and imports 47 percent. Domestic shipments were the lowest since 1933 and imports the smallest since 1935.

In spite of the curtailment in fluorspar mining, considerable prospecting and development work were done, several new mines came into production, new milling plants were under construction or completed at three properties, and improvements were made at other mills.

Total sales of fluorspar to consumers in the United States were 99,478 short tons in 1938 (79,615 tons from domestic mines and 19,863 tons from foreign sources) compared with 215,744 tons in 1937 (180,744 tons from domestic mines and 34,970 from foreign sources). Total sales to the steel industry decreased to 62,196 tons in 1938 (161,306 tons in 1937), while sales to manufacturers of hydrofluoric acid declined to 20,976 tons (27,779 tons in 1937) and those to makers of glass and enamel dropped to 12,902 tons (19,507 tons in 1937).

Despite the lessened demand for fluorspar in 1938 the average composite selling price of all grades of fluorspar (both domestic and foreign) delivered to consumers in the United States was virtually the same as in 1937. The average selling price f. o. b. Illinois-Kentucky mines of fluorspar shipped to steel plants was $18 a short ton ($18.89 in 1937) and that of fluorspar shipped to manufacturers of hydrofluoric acid was $25.29 ($27.49 in 1937). The average selling price of imported fluorspar shipped to steel plants was $20.56 a ton at seaboard (duty paid) in 1938 ($22.04 in 1937) and that of fluorspar shipped to manufacturers of hydrofluoric acid was $27.54 a ton ($26.60 in 1937).

Under the Anglo-American trade treaty, the duty on fluorspar containing more than 97 percent calcium fluoride was decreased from $5 a short ton to $3.75 a ton, effective January 1, 1939.



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*Salient statistics of the fluorspar industry in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Domestic shipments: | | | | |
| Gravel | 148,846 | $2,799,337 | 59,199 | $1,065,960 |
| Lump | 13,461 | 352,315 | 7,907 | 182,860 |
| Ground | 18,923 | 514,977 | 13,297 | 350,846 |
| | 181,230 | 3,666,629 | 80,403 | 1,599,666 |
| Stocks at mines or shipping points Dec. 31: | | | | |
| Ready-to-ship | 30,539 | (1) | 34,877 | (1) |
| Crude | 23,114 | (1) | 47,802 | (1) |
| | 53,653 | (1) | 82,679 | (1) |
| Imports for consumption: | | | | |
| Containing more than 97 percent $CaF_2$ | 10,248 | 162,145 | 9,216 | 192,469 |
| Containing not more than 97 percent $CaF_2$ | 26,815 | 235,482 | 10,406 | 95,174 |
| | 37,063 | 397,627 | 19,622 | 287,643 |
| Exports | 456 | 9,091 | 788 | 9,061 |
| Consumption (by industries): | | | | |
| Metallurgical | 152,100 | (1) | 81,400 | (1) |
| Ceramic | 18,100 | (1) | 14,800 | (1) |
| Chemical | 24,100 | (1) | 18,900 | (1) |
| | 194,300 | (1) | 115,100 | (1) |
| Stocks at consumers' plants Dec. 31: | | | | |
| Metallurgical | 75,000 | (1) | 57,800 | (1) |
| Ceramic | 5,200 | (1) | 2,800 | (1) |
| Chemical | 9,900 | (1) | 11,200 | (1) |
| | 90,100 | (1) | 71,800 | (1) |

[1] Figures not available.

Other important developments in 1938 were the initial importation of fluorspar from Mexico; first shipments of concentrates from the new flotation mill at Lordsburg, N. Mex.; exports of 541 tons to Japan; beginning of construction of flotation plants at Rosiclare, Ill., and Salida, Colo.; initial shipments by river and rail of fluorspar from Illinois to Atlantic coast consumers; and reduction of 23 percent in stocks of fluorspar at steel plants.

*Production and shipments.*—Fluorspar was known to have been produced in 1938 at 97 mines and prospects, and small quantities were recovered at an undetermined number of other prospects and reclaimed from mill ponds, waste dumps, and old workings of abandoned mines. All operations yielded about 99,000 short tons of merchantable fluorspar compared with about 183,000 tons in 1937. However, in spite of the large number of properties worked in 1938, 29 mines produced 88 percent of the total output.

Shipments of fluorspar from domestic mines in 1938 aggregated 80,403 short tons valued at $1,599,666, decreases of 56 percent in both quantity and total value from 1937. Shipments in 1938 were equivalent to 64 percent of the average annual tonnages shipped in the 5-year period 1926–30. Of the 1938 shipments, 20,862 tons were shipped by barge for delivery at upper Ohio River and tributary landings compared with 47,300 tons in 1937.

In 1938, mines operated by or for consumers shipped 13,226 short tons of fluorspar for use in their own plants compared with 31,700 tons in 1937.

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The average value of all grades of domestic fluorspar shipped was $19.90 a ton ($0.33 less than the 1937 average). The value recorded for domestic fluorspar is the price paid f. o. b. mine shipping point and excludes cost of containers.

In 1938, 5 ounces of optical fluorspar were sold for $5.

The following table gives details of shipments of fluorspar by States for 1938 that may be published without revealing, except by permission, operations of individual producers.

*Fluorspar shipped from mines in the United States in 1938, by States*

| State | Gravel [1] | | | Lump | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average | | Total | Average |
| Illinois | 26,324 | $507,620 | $19.28 | 4,203 | $164,245 | $23.86 |
| Kentucky | 27,520 | 492,692 | 17.90 | 2,680 | | |
| New Mexico | 765 | 40,169 | 11.94 | | | |
| Arizona | 668 | | | | | |
| Nevada | 1,930 | | | 852 | 18,615 | 18.18 |
| Colorado | 1,569 | 25,479 | 12.79 | 135 | | |
| Utah | 333 | | | 37 | | |
| New Hampshire | 90 | | | | | |
| Total: 1938 | 59,199 | 1,065,960 | 18.01 | 7,907 | 182,860 | 23.13 |
| 1937 | 148,846 | 2,799,337 | 18.81 | 13,461 | 352,315 | 26.17 |

| State | Ground [2] | | | Total | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average | | Total | Average |
| Illinois | 4,841 | $350,846 | $26.39 | 35,368 | $751,227 | $21.24 |
| Kentucky | 4,603 | | | 34,803 | 678,094 | 19.48 |
| New Mexico | 3,301 | | | 4,066 | 142,802 | 17.70 |
| Arizona | 425 | | | 1,093 | | |
| Nevada | 127 | | | 2,909 | | |
| Colorado | | | | 1,704 | 27,543 | 12.73 |
| Utah | | | | 370 | | |
| New Hampshire | | | | 90 | | |
| Total: 1938 | 13,297 | 350,846 | 26.39 | 80,403 | 1,599,666 | 19.90 |
| 1937 | 18,923 | 514,977 | 27.21 | 181,230 | 3,666,629 | 20.23 |

[1] Includes flotation concentrates shipped for use in making hydrofluoric acid and cement and run-of-mine fluorspar for use as flux in steel plants.
[2] Includes flotation concentrates shipped to the glass and enamel trades.

The following table shows domestic shipments, imports, exports, and consumption in the United States for the past 5 years.

*Domestic shipments, imports, exports, and consumption of fluorspar in the United States, 1934–38*

| Year | Domestic shipments | | Imports for consumption | | Exports | | Consumption |
|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons |
| 1934 | 85,786 | $1,391,405 | 16,705 | $183,286 | 522 | $8,602 | 110,600 |
| 1935 | 123,741 | 1,860,638 | 16,340 | 179,049 | 313 | 4,651 | 137,400 |
| 1936 | 176,877 | 3,119,668 | 25,504 | 256,262 | 240 | 4,079 | 182,400 |
| 1937 | 181,230 | 3,666,629 | 37,063 | 397,627 | 456 | 9,091 | 194,300 |
| 1938 | 80,403 | 1,599,666 | 19,622 | 287,643 | 788 | 9,061 | 115,100 |

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*Shipments, by uses.*—The predominance of the steel industry as a purchaser of fluorspar is evident from the following table:

*Fluorspar shipped from mines in the United States, 1937–38, by uses*

| Use | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|
| | Quantity | | Value | | Quantity | | Value | |
| | Percent of total | Short tons | Total | Average | Percent of total | Short tons | Total | Average |
| Steel | 75.62 | 137,040 | $2,536,074 | $18.51 | 64.67 | 51,991 | $912,111 | $17.54 |
| Foundry | 1.42 | 2,566 | 47,264 | 18.42 | 2.54 | 2,041 | 33,755 | 16.54 |
| Glass | 7.01 | 12,697 | 340,187 | 26.79 | 10.82 | 8,702 | 224,315 | 25.78 |
| Enamel | 3.34 | 6,054 | 166,186 | 27.45 | 5.10 | 4,100 | 109,165 | 26.63 |
| Hydrofluoric acid | 9.86 | 17,879 | 481,544 | 26.93 | 14.28 | 11,484 | 285,274 | 24.84 |
| Miscellaneous | 2.50 | 4,538 | 86,283 | 19.01 | 1.61 | 1,297 | 25,985 | 20.03 |
| | 99.75 | 180,774 | 3,657,538 | 20.23 | 99.02 | 79,615 | 1,590,605 | 19.98 |
| Exported | .25 | 456 | 9,091 | 19.94 | .98 | 788 | 9,061 | 11.50 |
| | 100.00 | 181,230 | 3,666,629 | 20.23 | 100.00 | 80,403 | 1,599,666 | 19.90 |

*Consumption and consumers' stocks.*—The following tables give data on consumption and stocks of fluorspar.

*Fluorspar consumed and in stock in the United States, 1937–38, by industries, in short tons*

[Partly estimated by Bureau of Mines]

| Industry | 1937 | | 1938 | |
|---|---|---|---|---|
| | Consumption | Stocks at consumers' plants Dec. 31 | Consumption | Stocks at consumers' plants Dec. 31 |
| Basic open-hearth steel | 138,900 | 71,400 | 73,600 | 55,000 |
| Electric furnace steel | 7,500 | 1,300 | 4,000 | 1,000 |
| Foundry | 2,500 | 800 | 2,000 | 800 |
| Ferro-alloys | 1,200 | 700 | 800 | 400 |
| Hydrofluoric acid | 24,100 | 9,900 | 18,900 | 11,200 |
| Enamel | 5,900 | 1,500 | 4,000 | 900 |
| Glass | 11,600 | 3,200 | 10,500 | 1,600 |
| Miscellaneous | 2,600 | 1,300 | 1,300 | 900 |
| | 194,300 | 90,100 | 115,100 | 71,800 |

*Consumption and stocks of fluorspar at basic open-hearth steel plants, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Production of basic open-hearth steel ingots and castings—long tons | 23,440,000 | 30,447,000 | 43,615,000 | 46,361,000 | 25,868,000 |
| Consumption of fluorspar in basic open-hearth steel production—short tons | 81,000 | 99,600 | 133,900 | 138,900 | 73,600 |
| Consumption of fluorspar per ton of steel made—pounds | 6.9 | 6.5 | 6.1 | 6.0 | 5.7 |
| Stocks of fluorspar on hand at steel plants at end of year—short tons | 45,500 | 47,500 | 59,200 | 71,400 | 55,000 |

The quantity of fluorspar used by individual plants per ton of basic open-hearth steel produced ranges from 1 to 50 pounds—a relatively small proportion of the furnace charge. The average is generally 5 to 8 pounds and dropped to 5.69 pounds in 1938 from 5.99 pounds in

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1937. It is noteworthy that since 1921, the first year for which data were collected, the average consumption of fluorspar per ton of basic open-hearth steel made has declined almost steadily from 8.2 to 5.7 pounds. The following table shows the variation in average consumption of fluorspar per ton of basic open-hearth steel over a 5-year period in certain plants that make about 88 percent of the total.

*Average consumption of fluorspar per ton of steel, 1934–38, in pounds*

| 1934 | 1935 | 1936 | 1937 | 1938 | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|---|---|---|---|
| 14.443 | 13.243 | 13.187 | 13.867 | 12.548 | 7.488 | 7.048 | 6.734 | 7.360 | 8.420 |
| 4.766 | 4.182 | 4.792 | 5.623 | 4.457 | 6.584 | 9.347 | 10.495 | 6.623 | 11.984 |
| 5.141 | 4.803 | 4.541 | 4.376 | 3.845 | 9.820 | 8.168 | 5.104 | 4.358 | 3.831 |
| 9.958 | 8.452 | 10.519 | 8.795 | 8.297 | 5.900 | 5.236 | 5.027 | 6.619 | 6.448 |
| 6.195 | 7.027 | 4.105 | 3.550 | 6.843 | 6.429 | 6.764 | 6.357 | 8.895 | 8.340 |
| 5.768 | 5.658 | 5.160 | 5.275 | 3.694 | 6.780 | 5.257 | 5.917 | 5.236 | 6.195 |
| 5.046 | 6.857 | 7.416 | 6.404 | 6.806 | 7.547 | 7.115 | 6.789 | 6.816 | 6.097 |

*Quoted prices.*—In 1938 the quoted price f. o. b. Illinois-Kentucky mines for fluxing gravel fluorspar was $20 a short ton for rail delivery and $22 for barge delivery at Ohio River landings. Imported fluxing gravel fluorspar (at seaboard, duty paid) was quoted at $23.50 to $24 a short ton.

*Stocks at mines or shipping points.*—According to reports of producers the total quantity of fluorspar in stock at mines or shipping points at the close of 1938 was 82,679 short tons, or about 54 percent more than in 1937. These stocks comprised about 47,800 tons of crude fluorspar (calculated to be equivalent to 28,000 tons of ready-to-ship fluorspar) and 34,877 tons of ready-to-ship fluorspar.

*Stocks of fluorspar at mines or shipping points in the United States, Dec. 31, 1937 and 1938, by States, in short tons*

| State | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Crude[1] | Ready-to-ship | Total | Crude[1] | Ready-to-ship | Total |
| California | 50 | | 50 | 50 | | 50 |
| Colorado | 260 | | 260 | 260 | | 260 |
| Illinois | 18,466 | 10,132 | 28,598 | 35,157 | 10,182 | 45,339 |
| Kentucky | 3,926 | 20,325 | 24,251 | 12,207 | 24,486 | 36,693 |
| Nevada | 75 | | 75 | | | |
| New Hampshire | 157 | 17 | 174 | | | |
| New Mexico | 132 | 65 | 197 | 20 | 209 | 229 |
| Texas | 48 | | 48 | 48 | | 48 |
| Utah | | | | 60 | | 60 |
| | 23,114 | 30,539 | 53,653 | 47,802 | 34,877 | 82,679 |

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

*Technologic developments.*—Commercial flotation of fluorspar in the United States is now about 10 years old; the process was first used commercially at Rosiclare, Ill., on March 18, 1929. Since that time plants have been completed and operated at Deming, Arrey, and Lordsburg, N. Mex., and Boulder, Colo. The mill at Boulder discontinued operations on fluorspar in 1937. Additional plants are under construction at Salida, Colo., and Rosiclare, Ill. Total output of flotation concentrates from 1929 through 1938 was 50,552 short tons.

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Mitchell, Gross, and Oehler [1] have reviewed briefly the work of other investigators on froth flotation of fluorspar and have presented the results of their studies, the object of which was to determine some of the fundmental froth flotation properties of fluorspar and the associated gangue minerals, quartz and calcite. These investigators summarize their findings as follows:

A sample of table tailings from a fluorspar mill, containing a high percentage of calcite, was analyzed for particle size and mineral content. The minus 48-mesh portion was then used to study some of the froth flotation properties of fluorite and associated gangue minerals, quartz and calcite.

The best concentrates and the highest recoveries were obtained with cell temperatures of from 60° to 90° C.

The amount of reagents and the pH of the ore pulp were found to have pronounced effects on the recoveries obtained. About 1 pound of sodium carbonate per ton of ore proved to be the optimum amount. The best pH was 8.5. Water glass of 1.40 sp. gr. was used to the extent of 0.12 lb. per ton of ore. The consumption of fatty acid depended somewhat upon the amounts of other reagents used; too much fatty acid lowered the grade of concentrate.

Tap water proved to be fully as satisfactory as distilled water in these tests. Stearic acid was used as a collector in one run and gave results similar to those obtained with oleic acid.

Generally speaking, the smaller sizes were more easily floated. Fluorite coarser than 65-mesh was difficult to float. The best selectivity indices were obtained with material between 65- and 150-mesh in size.

Clemmer and others [2] have recorded observations and data obtained in applying selective flotation to several ores from the Cave in Rock (Ill.) district. Both batch and continuous tests are given to show the application of flotation to the production of lead, zinc, and fluorspar concentrates. Approximately 85 tons of fluorspar were collected during these plant tests. Of this amount, 38 tons averaged 98.01 percent $CaF_2$ and 47 tons averaged 95.22 percent $CaF_2$. According to these investigators:

The results of laboratory batch and pilot-plant tests, followed by larger-scale tests, have successfully demonstrated the feasibility of flotation for the concentration of southern Illinois lead-zinc-fluorspar ores. Although much work remains to be done before the ultimate metallurgical practice is established, the tests have shown that acceptable lead, zinc, and fluorspar concentrates may be produced with satisfactory recoveries.

If the middlings are to be marketed as metallurgical fluorspar, agglomeration such as briquetting or sintering probably will be necessary to make the product acceptable to steel makers. In fact, experiments on sintering fluorspar were conducted in 1938 by the Mahoning Mining Co., which reported that results of laboratory work and of a large-scale test on 150 tons were quite satisfactory, both from the standpoint of performing the sintering operation and of use of the product by an open-hearth steel maker.

Some results of studies by the Bureau of Mines on lead-zinc-fluorspar middlings from Mexico, Ky., and Cave in Rock, Ill., and on fluorspar concentrates from Wilmore, Ky., are given in a recent report.[3]

A method of removing fluorspar from zinc concentrates is the subject of United States Patent 2137600, dated November 22, 1938.

A few tests of a new electrostatic process for the separation of fluorspar and associated minerals were made during 1938.

[1] Mitchell, D. R., Gross, H. E., and Oehler, H. E., Froth Flotation of Fluorspar: Am. Inst. Min. and Met. Eng. Tech. Pub. 999, November 1938, 13 pp.

[2] Clemmer, J. B., Duncan, W. E., DeVaney, F. D., and Guggenheim, M., Flotation of Southern Illinois Lead-Zinc-Fluorspar Ores: Progress Reports—Metallurgical Division. 31. Ore-Dressing Studies: Bureau of Mines Rept. of Investigations 3437, 1939, 31 pp.

[3] Dean, R. S., and others, Progress Reports—Metallurgical Division. 27. Ore-Testing Studies, 1937-38: Bureau of Mines Rept. of Investigations 3425, 1938, pp. 97-99.

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## INDUSTRY IN 1938, BY STATES

*Arizona.*—Shipments of fluorspar from Arizona were 1,093 short tons in 1938 compared with 610 tons in 1937. Production in 1938 came from the Polly Ann and Daniel Camp mines, near Duncan, Greenlee County. Most of the fluorspar from the Polly Ann mine was shipped to domestic steel plants and to Japan. The fluorspar from the Daniel Camp mine and some from the Polly Ann mine moved to the flotation plants at Deming and Lordsburg, N. Mex. The flotation concentrates recovered from the fluorspar, instead of the run-of-mine material produced, have been credited to Arizona in the statistics.

*California.*—A plant for grinding fluorspar for the ceramic trade was constructed at West Berkeley the latter part of 1938.

*Colorado.*—Shipments of fluorspar from Colorado were 1,704 short tons in 1938 compared with 7,883 tons in 1937. Of the 1938 shipments, 1,465 tons went to steel plants, 135 tons to iron foundries, 44 tons to ferro-alloy plants, and 60 tons to hydrofluoric-acid plants. Shipments in 1938 comprised 104 tons from Boulder County and 1,600 tons from Chaffee County.

A mill comprising jigs and flotation machines was reported under construction by the Colorado Fluorspar Corporation, Salida, Colo.

*Illinois.*—Approximately 75,000 short tons of fluorspar-bearing rock, equivalent to 46,000 tons of merchantable fluorspar, were mined at 30 mines or prospects in 1938 compared with about 138,000 tons, equivalent to 81,000 tons of merchantable fluorspar, mined at 26 mines or prospects in 1937. Of the merchantable fluorspar produced in 1938, 38,000 tons were from mines where the fluorspar occurs in veins, chiefly in fault fissures, and 8,000 tons from mines where the fluorspar occurs in flat-lying tabular masses, locally called blanket formations.

Fluorspar-bearing material milled in Illinois in 1938 totaled 59,000 tons, from which 36,000 tons of fluorspar were recovered—a ratio of 1.639 : 1.

Shipments from Illinois were 35,368 tons in 1938 compared with 78,664 tons in 1937. Of the total, 13,572 tons were shipped by barge for delivery at upper Ohio River and tributary landings compared with 31,552 tons in 1937.

The Argo, Blue Diggings, Crystal, Daisy, Good Hope, Hamp, Hillside, Lee, and Spar Mountain mines supplied about 89 percent of the total merchantable fluorspar produced in Illinois in 1938. Most of the remainder came from the Boundary Shaft, Douglas, Humm, Lead Hill, Stewart, and Victory mines.

Development work at the Daisy mine in 1938 consisted of drifting 150 feet on the 800-foot level of the Daisy vein and driving a crosscut from the Daisy vein to the Blue Diggings vein which encountered 5 feet of good fluorspar. It was believed that the crosscut would show that the Daisy and Blue Diggings veins intersected at the 800-foot level. However, according to A. H. Cronk, the junction of the two veins has not yet been determined; in fact, the Blue Diggings vein shows indications of straightening, which would make the two veins meet below the 800-foot level. A considerable tonnage of acid-grade fluorspar was produced directly from the stopes on the Blue Diggings vein.

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The Rosiclare Lead & Fluorspar Mining Co. made important additions to its power plant at Rosiclare. A new steel, brick, and concrete building was completed to house a 1,250-kilowatt and a 1,000-kilowatt turbine generator and two 600-horsepower boilers. Water for condensing purposes in the turbo-generators will be pumped directly from the Rosiclare mine by a 3,000-gallon-per-minute pump which has been installed in the Rosiclare shaft. The water in the Rosiclare mine will be lowered to approximately the 250-foot elevation, which will permit mining above this level on the Rosiclare vein. The Rosiclare mine has been inactive since January 1924, when it was flooded.

The Mahoning Mining Co. continued prospecting and development at its property about 8 miles north of Cave in Rock. Up to April 15, 1939, 125 churn-drill holes, 300 to 400 feet deep, had been put down and 2 shafts sunk. According to A. G. Johnson, mineralization in the new area now being developed does not appear to be as widespread as that in the section to the southwest near the escarpment. However, 3 bedded deposits have been located in an area about 1 mile square. One ore body occurs in the Fredonia limestone at the base of the Rosiclare sandstone, 1 in the Renault limestone at the base of the Bethel sandstone and 100 feet above the base of the Rosiclare sandstone, and 1 at the sub-Rosiclare horizon 50 to 60 feet below the base of the Rosiclare sandstone. Because of the prevailing dip (about 5°) of the formations to the northeast, the ore bodies lie much deeper than those to the southwest, but their fluorspar content is not as high. In addition to fluorspar, appreciable quantities of zinc, lead, and secondary quartz as well as smaller quantities of barite occur in the ore bodies, all more or less finely disseminated throughout the mass. In the ore body in the sub-Rosiclare horizon the lead-zinc content of the ore is high enough to be of economic importance. In the other 2 ore bodies it appears to be too low. The ore body in the sub-Rosiclare horizon has now been developed by a 300-foot shaft and several hundred feet of crosscutting. The ore body in the Renault limestone has been developed by a 160-foot shaft and 200 feet of drifting.

The Mahoning Mining Co. started construction at Rosiclare of a milling plant designed to treat 200 tons of lead-zinc-fluorspar ore in 24 hours; it is planned to have it in operation in May 1939. The plant will comprise a jaw crusher, a cone crusher, a vibrating screen, a ball mill, and three banks of flotation machines, one each for lead, zinc, and fluorspar. The fluorspar concentrates will be filtered and dried in a department separate from the flotation unit. Power for the plant will be supplied by the Rosiclare Lead & Fluorspar Mining Co. The crude ore will be trucked from the mine to the mill.

At the Victory mine 3,984 feet of diamond-core drilling was done in 1938.

At the Blue Diggings mine on the Blue Diggings vein, where the shaft was sunk from 538 to 720 feet in 1937, the 600- and 700-foot levels were driven north 160 and 600 feet, respectively, in a vein of fluorspar averaging 3 feet in width.

The 500-foot level of the Argo mine was driven north 380 feet and south 400 feet from the Blue Diggings-Argo crosscut. The vein of fluorspar in the north drift averaged 3 feet in width. The vein in the south drift started at a width of 2 feet but pinched out a short

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distance from the crosscut. The drift was continued, and at slightly more than 200 feet from the crosscut a 2-foot vein was found which at 250 feet widened to 5 feet. At this point the drift broke through into a cavern 40 feet along the vein, 40 feet wide, and 90 feet high. The entire cavity was lined with marcasite studded with calcite crystals. The drift was continued along the east wall of the cavern in a 5-foot vein of fluorspar.

A new shaft 100 feet deep was sunk on the East-West vein at the Hamp mine. The 100-foot level was driven west 80 feet in low-grade ore. From this point a winze was sunk 60 feet in good fluorspar and a level driven west 100 feet.

Substantial improvements were made in the flotation mill of the Aluminum Ore Co. at Rosiclare.

Some development work was done at the Cave in Rock, Hardin Minerals, Jackson, Lacey, Pell, and Preen properties.

*Kentucky.*—Production of merchantable fluorspar in Kentucky was about 43,000 short tons in 1938 compared with 87,000 tons in 1937, and shipments were 34,803 tons compared with 87,296 tons in 1937. Of the 1938 shipments, 7,290 tons were shipped by barge for delivery at upper Ohio River and tributary landings compared with 15,748 tons in 1937.

Virtually the entire output of fluorspar in Caldwell County in 1938 came from the Hollowell & Hobby mine, near Princeton.

Production in Crittenden County, amounting to approximately 15,000 tons, came chiefly from the Bachelor, Beard, Butler, Davenport, Hodge, Keystone, Lafayette, Memphis, Pigmy, and Susie Beeler mines, which contributed about 85 percent of the output of Crittenden County. Production was 49,000 tons in 1937.

In Livingston County about 24,000 tons of merchantable fluorspar were produced in 1938 compared with 35,000 tons in 1937. The chief producing mines were the C. R. Babb, Klondike, and Nancy Hanks mines, which accounted for 93 percent of the output of Livingston County.

In 1938 the Faircloth mine near Wilmore, Woodford County, shipped 300 tons of fluxing-gravel and 150 tons of acid lump fluorspar, and the Twin Chimney mine near Mundys Landing, Mercer County, shipped 150 tons of fluxing-gravel fluorspar.

*Montana.*—The Boeing prospect near Austin, Lewis and Clark County, was being developed in 1938.

*Nevada.*—Shipments of fluorspar from Nevada were 2,909 short tons in 1938 compared with 2,544 tons in 1937. Of the 1938 shipments, 1,881 tons went to steel plants, 292 tons to glass and enamel makers, 686 tons to hydrofluoric-acid manufacturers, and 50 tons to cement plants.

The chief producing mine in Nevada in 1938 was the Baxter, in Mineral County, which shipped 2,142 tons. The other active mine was the Daisy, in Nye County, which shipped 767 tons, including 127 tons of ground fluorspar.

*New Hampshire.*—Fluorspar activity at the Stoddard mine near Westmoreland, Cheshire County, in 1938 was confined to milling some ore previously mined and to shipping 78 tons to steel plants and 12 tons to foundries.

*New Mexico.*—Shipments of fluorspar from New Mexico were 4,066 short tons in 1938 compared with 3,324 tons in 1937 and comprised

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3,464 tons of high-grade flotation concentrates and 602 tons of metallurgical-grade fluorspar.

Production came chiefly from the Sadler mine in Luna County; Big Spar mine in Catron County; White Eagle, Shrine, Bitter Creek, and Rain Creek mines in Grant County; "Dean" mine in Hidalgo County; Lyda K mine in Sierra County; and Mallery mine in Valencia County.

Initial shipments of concentrates were made from the new flotation mill at Lordsburg.

The General Chemical Co., a large consumer of acid-grade fluorspar, acquired the flotation plant of the La Purisima Fluorspar Co. in October 1938; the mill capacity has been tripled.

*Utah.*—Shipments of fluorspar from Utah were 370 short tons in 1938 compared with 431 tons in 1937. Virtually all shipments in 1938 came from the Monarch claims in Beaver County; a little came from Tooele County. Of the 1938 shipments, 295 tons went to steel plants, 37 tons to foundries, and 38 tons to Japan.

At the Dalton property, also in Beaver County, development work was continued, in the course of which a small quantity of fluorspar was mined; a mill, consisting of rolls, a trommel screen, and a four-cell jig, was completed.

A small quantity of fluorspar was mined (but not shipped) at the Utah Fluorspar Co. property, also in Beaver County.

## OPTICAL FLUORSPAR

Optical fluorspar, which is rather rare and difficult to obtain, has been found occasionally in mines in the Illinois-Kentucky district, in the Central Kentucky district, and in some Western States, chiefly California. Although there is a limited market for flawless, transparent crystals of fluorspar, apparently the demand is only partly supplied from domestic sources. In 1938, for example, only 5 ounces of optical fluorspar valued at $5 were reported sold by domestic producers.

Lithium fluoride crystals, now made commercially in the United States, are reported to make an excellent substitute for optical fluorite.[4] These crystals are said to have optical characteristics similar to fluorite and to show transparency considerably farther in the ultraviolet.

## IMPORTS AND EXPORTS[5]

Imports of fluorspar for consumption in the United States in 1938 totaled 19,622 short tons (9,216 tons containing more than 97 percent and 10,406 tons containing not more than 97 percent calcium fluoride) valued[6] at $287,643, compared with 37,063 tons (10,248 tons containing more than 97 percent and 26,815 tons containing not more than 97 percent calcium fluoride) valued[6] at $397,627 in 1937. The value assigned to the foreign fluorspar in 1938 averaged $14.66 a ton. The cost to consumers in the United States also includes duty, loading

[4] Industrial and Engineering Chemistry, News Ed., vol. 16, No. 21, Nov. 10, 1938, p. 584.

[5] Figures on imports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce; those on exports supplied by the producers. No exports of fluorspar recorded by the Bureau of Foreign and Domestic Commerce.

[6] As defined in sec. 402 of the tariff act of 1930, "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States."

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charges at the docks, ocean freight, insurance, consular fee, and freight from docks to consuming points. The duty on fluorspar containing more than 97 percent calcium fluoride was decreased from $5 a short ton to $3.75 a ton, effective January 1, 1939. The duty on fluorspar containing not more than 97 percent calcium fluoride remained $7.50 a short ton.

Of the 1938 imports, 52.8 percent was metallurgical gravel fluorspar, 0.5 percent ceramic ground fluorspar, and 46.7 percent acid lump fluorspar. The metallurgical gravel fluorspar was imported from France, Newfoundland, Spain, Tunisia, and the United Kingdom; the ceramic ground fluorspar from France and Germany; and the acid lump fluorspar from Germany, Mexico, Newfoundland, Tunisia, and the Union of South Africa. Imports were equivalent to 24 percent of the total shipments of domestic fluorspar in 1938 compared with 20 percent in 1937.

*Fluorspar imported for consumption in the United States in 1938, by countries and customs districts*

| Country and customs district | Containing more than 97 percent calcium fluoride | | Containing not more than 97 percent calcium fluoride | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| France: | | | | | | |
| Buffalo | | | 1,221 | $12,923 | 1,221 | $12,923 |
| Maryland | | | 3,776 | 23,341 | 3,776 | 23,341 |
| New York | 22 | $591 | | | 22 | 591 |
| Philadelphia | 17 | 333 | 2,375 | 29,909 | 2,392 | 30,242 |
| | 39 | 924 | 7,372 | 66,173 | 7,411 | 67,097 |
| Germany: | | | | | | |
| Los Angeles | 17 | 411 | | | 17 | 411 |
| Philadelphia | 3,045 | 50,893 | | | 3,045 | 50,893 |
| | 3,062 | 51,304 | | | 3,062 | 51,304 |
| Mexico: New York | 85 | 1,263 | | | 85 | 1,263 |
| Newfoundland: | | | | | | |
| Buffalo | | | 1,344 | 16,292 | 1,344 | 16,292 |
| New York | (1) | 9 | 18 | 274 | 18 | 283 |
| Philadelphia | 3,390 | 87,334 | | | 3,390 | 87,334 |
| | 3,390 | 87,343 | 1,362 | 16,566 | 4,752 | 103,909 |
| Spain: Philadelphia | | | 309 | 3,535 | 309 | 3,535 |
| Tunisia: Philadelphia | 853 | 13,588 | 719 | 4,663 | 1,572 | 18,251 |
| Union of South Africa: | | | | | | |
| Maryland | 241 | 5,007 | | | 241 | 5,007 |
| New York | 847 | 17,902 | | | 847 | 17,902 |
| Philadelphia | 699 | 15,138 | | | 699 | 15,138 |
| | 1,787 | 38,047 | | | 1,787 | 38,047 |
| United Kingdom: Philadelphia | | | 644 | 4,237 | 644 | 4,237 |
| Total: 1938 | 9,216 | 192,469 | 10,406 | 95,174 | 19,622 | 287,643 |
| 1937 | 10,248 | 162,145 | 26,815 | 235,482 | 37,063 | 397,627 |

[1] Less than 1 ton.

The following table, compiled from data furnished the Bureau of Mines by importers, shows the quantities of imported fluorspar delivered to consumers in the United States in 1937 and 1938 and the selling price at tidewater (duty paid), irrespective of the year of importation into the United States; it differs from the preceding table, which shows the quantities received in the United States during 1937

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and 1938. The quantities in the following table are based on the actual outturn weights ascertained by sworn weighers and represent the weights on which duty was paid and entries were liquidated. Stocks of foreign fluorspar in the hands of importers in the United States were 1,165 short tons at the close of 1938.

*Imported fluorspar delivered to consumers in the United States, 1937–38*

| Industry | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Selling price at tidewater, including duty | | Short tons | Selling price at tidewater, including duty | |
| | | Total | Average | | Total | Average |
| Steel | 24,266 | $534,826 | $22.04 | 10,205 | $209,801 | $20.56 |
| Glass | 166 | 6,205 | 37.38 | 11 | 418 | 38.00 |
| Enamel | 590 | 21,885 | 37.09 | 89 | 2,254 | 25.33 |
| Hydrofluoric acid | 9,900 | 263,336 | 26.60 | 9,492 | 261,399 | 27.54 |
| Cement | 48 | 1,073 | 22.35 | | | |
| Miscellaneous | | | | 66 | 1,546 | 23.42 |
| | 34,970 | 827,325 | 23.66 | 19,863 | 475,418 | 23.93 |

Producers of fluorspar reported exports of 788 short tons valued at $9,061 in 1938 compared with 456 tons valued at $9,091 in 1937. Of the 1938 exports, 247 tons went to Canada and 541 tons to Japan.

*Fluorspar reported by producers as exported from the United States, 1934–38*

| Year | Short tons | Value | | Year | Short tons | Value | |
|---|---|---|---|---|---|---|---|
| | | Total | Average | | | Total | Average |
| 1934 | 522 | $8,602 | $16.48 | 1937 | 456 | $9,091 | $19.94 |
| 1935 | 313 | 4,651 | 14.86 | 1938 | 788 | 9,061 | 11.50 |
| 1936 | 240 | 4,079 | 17.00 | | | | |

## WORLD PRODUCTION

The following table shows the production of fluorspar by countries from 1934 to 1938, inclusive, insofar as statistics are available. Complete returns for 1938 are not yet available, but except for the U. S. S. R. those for 1937 are nearly complete. If the output of the U. S. S. R. is estimated roughly at 70,000 tons in 1937, world production of about 522,000 metric tons is indicated, of which the United States furnished 32 percent, Germany 28 percent, the U. S. S. R. 13 percent, France 10 percent, and the United Kingdom 8 percent—a total of 91 percent.

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*World production of fluorspar, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Argentina [1] | 311 | 403 | 450 | (2) | (2) |
| Australia: | | | | | |
| New South Wales | 203 | 420 | 339 | 55 | (2) |
| Queensland | 1,328 | 185 | 487 | 1,410 | 2,479 |
| South Australia | 234 | 91 | 23 | | (2) |
| Canada | 136 | 68 | 68 | 136 | 197 |
| China | 5,050 | (2) | (2) | (2) | (2) |
| Chosen | 12,099 | 9,722 | 8,740 | 11,000 | (2) |
| France | 14,100 | 22,750 | 30,600 | 51,430 | (2) |
| Germany: | | | | | |
| Anhalt | 7,357 | 8,068 | 11,225 | 13,662 | (2) |
| Baden | 6,527 | 3,941 | 7,359 | 13,637 | (2) |
| Bavaria | 29,661 | 31,277 | 49,153 | 62,455 | (2) |
| Prussia | 21,555 | 24,618 | 36,271 | 30,514 | (2) |
| Saxony | 4,945 | 6,938 | 7,990 | 8,074 | (2) |
| Thuringia | (2) | 23,572 | 18,792 | 16,117 | (2) |
| Italy | 9,668 | 8,424 | 11,437 | 13,385 | (2) |
| Mexico [4] | 900 | 900 | 900 | 900 | 900 |
| Newfoundland (shipments) | 2,535 | 4,082 | 8,498 | 8,479 | 8,944 |
| Norway | 673 | 1,067 | 1,013 | 1,093 | (2) |
| South-West Africa | | | | | 585 |
| Southern Rhodesia | | | | | 156 |
| Spain | 6,365 | (2) | (2) | (2) | (2) |
| Switzerland | [4] 1,000 | | | | (2) |
| Tunisia | | | | 1,676 | 2,060 |
| Union of South Africa | 1,578 | 1,980 | 3,123 | 3,615 | 4,736 |
| U. S. S. R. | 27,000 | 49,100 | 65,000 | (2) | (2) |
| United Kingdom | 34,765 | 31,646 | 33,491 | 42,837 | (2) |
| United States (shipments) | 77,823 | 112,255 | 160,459 | 164,408 | 72,940 |
| | 286,000 | 353,000 | 465,000 | (2) | (2) |

[1] Railway shipments.
[2] Data not available.
[3] Data not available; estimate included in total.
[4] Estimated.

*France.*—The production of fluorspar in France, which reached an all-time peak of 58,660 metric tons in 1930, declined to 14,100 tons in 1934, and many mines were closed permanently. Since 1935 several mines have been reopened, and production has advanced progressively to 51,430 metric tons in 1937, the latest year for which statistics are available. Production undoubtedly declined in 1938, partly because of decreased exports. In 1938, for example, imports of fluorspar into the United States from France were only 7,411 short tons compared with 14,158 tons in 1937.

*Production of fluorspar in France, 1930 and 1935–37, by Departments, in metric tons*

| Department | 1930 | 1935 | 1936 | 1937 | Department | 1930 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|---|---|---|---|
| Ardèche | 1,250 | | | | Nièvre | 150 | | | |
| Ardennes | 160 | 450 | 550 | 150 | Puy-de-Dôme | 4,000 | 3,000 | 4,950 | 4,630 |
| Aveyron | 600 | | | 2,530 | Rhône | 1,400 | | 2,150 | 3,510 |
| Haute-Loire | 5,700 | 9,900 | 13,000 | 15,710 | Saône-et-Loire | 17,400 | 7,400 | 5,900 | 9,920 |
| Indre | 800 | 300 | | | Var | 27,200 | 1,700 | 4,050 | 14,980 |
| | | | | | | 58,660 | 22,750 | 30,600 | 51,430 |

The present status of the French fluorspar industry has been discussed and the chief mines have been described by Chermette.[7]

The following notes pertaining to the Font-Sante, Garrot, and "Luc" mines in the Department of Var, which export to the United States, have been taken from the article by Chermette.

[7] Chermette, A., Le Spath-fluor français en 1938. (French Fluorspar in 1938): Mines, Carrières, vol. 17, No. 193, Paris, November 1938, pp. 1–13.

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The Font-Sante mine suspended operations in 1933, after having exported 50,000 tons of fluorspar. In 1935 the mine was reopened and small shipments were made to the United States; in 1936 exports were increased. In 1937 the mine was operated at the rate of 1,200 tons monthly. Several veins are mined, of which one attains an average width of 4 meters (13.1 feet) over a length of 60 meters (197 feet). Fluorspar-bearing rock from the mine is sent to the washery by means of an aerial ropeway 1,800 meters (5,905 feet) long.

The Garrot mine, near the Font-Sante, was formerly active, but operations were suspended in 1932. The mine was reopened in August 1937. Mine equipment has been electrified and a modern washery is to replace the older plant. The equipment will handle a monthly production of 1,000 tons.

In 1937 a new mine at Luc was opened, and a production of 12 tons daily was attained. A washery of 15 tons daily capacity was being constructed.

*Germany.*—Germany is second only to the United States as a producer of fluorspar but it is the chief exporting country. In 1937, for example, production was 144,459 metric tons; and exports were 46,009 metric tons, of which 12,699 metric tons went to the United States. Fluorspar was produced at 36 mines in 1937—1 in Anhalt, 2 in Baden, 18 in Bavaria, 5 in Prussia, 3 in Saxony, and 7 in Thuringia. Figures on production are not yet available for 1938, but exports decreased to 27,316 metric tons, of which 2,812 metric tons went to the United States. No fluorspar from Germany was received in the United States from August 1938 to March 1939.

*Newfoundland.*—Shipments of fluorspar from Newfoundland in 1938 were 9,859 short tons, of which 1,404 tons of fluxing grade, 3,548 tons of acid grade, and 15 tons for experimental purposes went to the United States; 2,539 tons of fluxing grade, 1,116 tons of acid grade, and 1,237 tons of special-grade lump (93 to 95 percent $CaF_2$) went to Canada. Shipments were 9,346 short tons in 1937.

The geological features of the fluorspar deposits of Newfoundland, the veins, and the mining and milling practices have been described by Howse.[8] The paper is accompanied by a mill flow sheet of the St. Lawrence Corporation of Newfoundland, Ltd., and a map showing the fluorspar veins. The veins are described as follows:

> The veins vary in width from 6 inches to 14 feet of solid fluorspar, and in places a width of fluorspar and granite breccia up to 35 feet is to be found. The presence of included granite is often a deciding factor in the economic value of the vein. Up to the present time it has been the practice to mine those veins which have the smallest proportion of granite, as this lowers appreciably the cost of hand picking. The length of the veins, as exposed to date, varies from 7,700 feet in the case of the Blue Beach vein to 200 feet in the case of the smallest known veins of the area. However, it may be said that in no case has a fissure vein been followed along its entire course, or even until it has narrowed beyond the point of economic mining.
>
> The most promising veins known to date are the Black Duck, Iron Springs, Blue Beach, Tarefare, Director, Lord and Lady Gulch, Red Head, Doctor's Pond, Scrape, Hookey, Grassy Gulch, Little Salt Cove, Morris, New Morris and Blake's Brook. It is interesting to note that all the veins strike within 45° southeast and 45° northwest of the general strike of the granite stock.
>
> This vein [Black Duck] is the most extensively worked to date. It has been mined to a depth of 180 feet, and shaft sinking is now in progress to a greater depth. The vein pinches and swells, both horizontally and vertically, from 6 inches to 8 feet. The average width is 4 feet and at the 180-foot level it appears to be quite as strong as it is at the surface. The dip is vertical and the vein has been mined

[8] Howse, C. K., St. Lawrence Fluorspar Mines: Newfoundland Geol. Survey Inf. Circ. 4, 1938, pp. 26–32.

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laterally for 450 feet, with no diminution in width laterally. The vein is made up practically of pure fluorite, the only gangue materials being small amounts of sulfides of copper and zinc and granite breccia. This breccia makes up the greatest part of the gangue and usually is easily hand-picked, leaving a very high fluorspar concentrate.

The Iron Springs vein, next to the Black Duck vein, is best developed to date. Sinking has continued from the surface to a depth of 55 feet, and a dam has been erected near its intersection with Salt Cove Brook. The fluorspar in this vein is of higher grade than Black Duck, as there is less included granite breccia. This vein can be mined and shipped, with very little hand picking, as acid-grade ore. It varies in width from 2 feet to 9 feet with very clean walls at all points investigated to date. The vein dips at an angle of 68°, and a shaft is now being sunk to the 100-foot level where drifting east and west will begin. Mining has been done for a distance of 450 feet along strike.

Other veins on which mining has been done by open-cut contract are: The Scrape from which about 300 tons have been extracted, Doctor's Pond from which about 800 tons have been taken, Hare's Ears from which 2,000 tons have been mined, Blue Beach which has been mined on the No. 2 and No. 3 veins, about 1,500 tons having been extracted. Contracting began in December 1936 on the Lord and Lady Gulch and New Morris veins. The fluorspar in these veins is not as high grade as that of the Black Duck and Iron Springs, though "steel grade" can be produced with a little hand picking.

*Tunisia.*—Production of fluorspar in Tunisia, which was inaugurated in 1937, increased from 1,676 metric tons to 2,060 tons in 1938. Imports into the United States in 1938 comprised 719 short tons of fluxing grade and 853 tons of acid grade.

*Union of South Africa.*—Production of fluorspar in the Union of South Africa advanced to 5,221 short tons in 1938 from 3,985 tons in 1937, owing chiefly to greatly increased exports to the United States and to demand from Japan.

## CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. It is used in the metallurgy of aluminum, in the manufacture of glass and enamels, and in insecticides.

Gibbs [9] has described the mine at Ivigtut, grades of ore produced, methods of processing and purification, and various uses of cryolite.

British Patent 463092 covers improvements in the manufacture and production of synthetic cryolite.

*Imports.*—The following table shows imports of cryolite into the United States in 1937 and 1938. As cryolite is mined only in Greenland, it is evident that importations credited to countries other than Greenland probably include artificial cryolite.

*Cryolite (natural and artificial) imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Long tons | Value | Long tons | Value |
| Canada | 1,328 | $154,256 | ---------- | ---------- |
| Denmark | 994 | 159,778 | ---------- | ---------- |
| France | 364 | 53,593 | 74 | $11,579 |
| Germany | 2,174 | 389,817 | 333 | 63,027 |
| Greenland | 11,826 | 723,740 | 11,708 | 711,000 |
| United Kingdom | 4 | 957 | ---------- | ---------- |
| | 16,690 | 1,482,141 | 12,115 | 785,606 |

[9] Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemical Raw Material: Chem. Ind., vol. 38, May 1936, pp. 471–476.

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# FELDSPAR

By Robert W. Metcalf

## SUMMARY OUTLINE


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The quantity of feldspar sold or used in the United States dropped sharply in 1938. The tonnage of both crude and ground spar fell far short of the records realized in 1936 and 1937, but remained higher than in 1935 and compared favorably with the best predepression

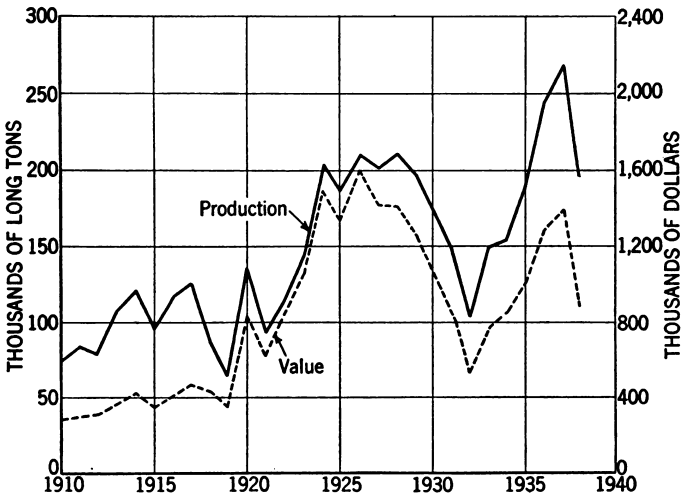


FIGURE 1.—Trends in production and value of crude feldspar in the United States, 1910–38.

levels. The average value per ton of the national output in 1938, however, was the lowest in many years.

Figure 1 shows trends in the domestic crude-feldspar industry since 1910.

Output of crude feldspar in 1938 amounted to 196,119 long tons valued at $895,081, a decrease of 27 percent in tonnage and 35 percent in value from 1937.

Continued experimentation with froth flotation and agglomerate tabling and a revival of investigations on electrostatic separation were of outstanding interest to the industry in 1938. Three mills are now processing nepheline syenite imported from Canada, and in



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November a plant to produce a new fluxing material called "aplite," which has about the same alumina content as nepheline, was put into operation in Virginia. Two new feldspar grinding mills were either under construction or contemplated at the end of the year.

Low-cost western feldspar from South Dakota and Colorado contributed 36 percent of the total crude feldspar output in 1938. North Carolina retained its rank as the largest producing State, but South Dakota displaced Colorado as the second largest producer. All other States, except Arizona and Connecticut, reported decreases in crude-spar output in 1938 compared with 1937. Owing to the larger proportion of western feldspar, the average value per long ton of crude spar in 1938 decreased to $4.56, a drop of 12 percent from 1937.

Sales of ground feldspar by merchant mills in 1938 totaled 214,514 short tons valued at $2,466,252, a decline of 23 percent in tonnage and 29 percent in value compared with 1937. About 4 percent of the total feldspar ground in 1938 came from Canada.

*Salient statistics of the feldspar industry in the United States, 1937–38*

| | 1937 | 1938 | Percent change in 1938 |
|---|---|---|---|
| Crude feldspar: | | | |
| Domestic sales: | | | |
| Long tons | 268,532 | 196,119 | −27.0 |
| Value | $1,383,249 | $895,081 | −35.3 |
| Average per long ton | $5.15 | $4.56 | −11.5 |
| Imports: | | | |
| Long tons | 12,956 | 7,652 | −40.9 |
| Value | $91,885 | $56,133 | −38.9 |
| Average per long ton | $7.09 | $7.34 | +3.5 |
| Ground feldspar sold by merchant mills: | | | |
| Short tons | 279,272 | 214,514 | −23.2 |
| Value | $3,486,741 | $2,466,252 | −29.3 |
| Average per short ton | $12.49 | $11.50 | −7.9 |

## DOMESTIC PRODUCTION

In accordance with the usual practice in the industry, crude spar is reported in long tons of 2,240 pounds and ground spar in short tons of 2,000 pounds.

*Crude feldspar.*—In 1938, 196,119 long tons of crude feldspar worth $895,081 were sold or used in the United States, a decrease of 27 percent in tonnage and 35 percent in value from 1937. Owing to the relatively low value and greater output of western spar, the average sales realization in 1938 for the country as a whole dropped to $4.56 per long ton, the lowest figure since 1917.

*Crude feldspar sold or used by producers in the United States, 1934–38*

| Year | Long tons | Value | | Year | Long tons | Value | |
|---|---|---|---|---|---|---|---|
| | | Total | Average | | | Total | Average |
| 1934 | 154,188 | $853,136 | $5.53 | 1937 | 268,532 | $1,383,249 | $5.15 |
| 1935 | 189,550 | 1,005,021 | 5.30 | 1938 | 196,119 | 895,081 | 4.56 |
| 1936 | 244,726 | 1,303,090 | 5.32 | | | | |

Crude feldspar was produced commercially in 12 States in 1938, the same number as in 1937. No output was reported from Mary-

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land, and Wyoming appears as a producer for the first time. North Carolina retained its rank as the largest producing State in spite of a drop in output to 56,795 long tons in 1938 from 94,595 tons in 1937 and 102,393 tons in 1936. South Dakota displaced Colorado as the second largest producer of crude spar and increased its output to 42,297 tons in 1938, 2 percent over the 1937 figure. Colorado's production, however, declined to 27,452 tons in 1938, or 35 percent below the 1937 figure. Substantial decreases were reported from all other States except Arizona and Connecticut. The output in Arizona, although small, increased considerably.

The average values per long ton f. o. b. mine in 1938 were $3.81 and $2.90 in Colorado and South Dakota, respectively, compared with $4.94 in Maine, $5.31 in New Hampshire, and $5.21 in North Carolina.

*Crude feldspar sold or used by producers in the United States, 1936–38, by States*

[Value at mine or nearest shipping point]

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Long tons | Value | Long tons | Value | Long tons | Value |
| Arizona | (1) | (1) | (1) | (1) | (1) | (1) |
| California | 4,700 | $41,050 | 1,836 | $9,660 | 1,396 | $7,675 |
| Colorado | 25,806 | 101,950 | 42,221 | 178,148 | 27,452 | 104,673 |
| Connecticut | (1) | (1) | (1) | (1) | 7,461 | 45,153 |
| Maine | 16,392 | 91,265 | 20,191 | 110,928 | 13,764 | 68,047 |
| Maryland | (1) | (1) | (1) | (1) | | |
| New Hampshire | 26,494 | 157,729 | 28,831 | 155,925 | 25,555 | 135,760 |
| New York | (1) | (1) | (1) | (1) | (1) | (1) |
| North Carolina | 102,393 | 591,053 | 94,595 | 538,567 | 56,795 | 295,800 |
| Pennsylvania | 144 | 828 | (1) | (1) | (1) | (1) |
| South Dakota | 32,144 | 103,671 | 41,392 | 158,976 | 42,297 | 122,467 |
| Virginia | 20.459 | 114,807 | 22,175 | 125,396 | 9,766 | 52,037 |
| Wyoming | | | | | 1,168 | 4,343 |
| Undistributed | 16,194 | 100,737 | 17,291 | 105,649 | 10,465 | 59,126 |
| | 244,726 | 1,303,090 | 268,532 | 1,383,249 | 196,119 | 895,081 |

[1] Included under "Undistributed."

*Ground feldspar.*—Sales of ground feldspar in 1938 from 30 merchant mills declined to 214,514 short tons worth $2,466,252, 23 percent less in tonnage and 29 percent less in value than in 1937. The 30 mills (1 less than in 1937) represented 23 producing companies operating in 14 States. Western mills (two in Colorado and two in South Dakota) furnished 35 percent of the total ground spar sold in 1938 compared with 30 percent in 1937 and 23 percent in 1936. The combined share of North Carolina and Tennessee mills, on the other hand, represented only 29 percent of the total in 1938 compared with 33 percent in 1937 and 36 percent in 1936. Three mills grinding imported Canadian spar in 1938 produced about 4 percent of the total quantity of ground feldspar sold compared with four mills producing 6 percent in 1937. Additional quantities of domestic and perhaps imported spar are ground by certain companies for use in their own plants and are not included in the Bureau of Mines statistics, but the quantity is believed to be small compared with the output of merchant mills.

In 1938 South Dakota for the first time produced more ground feldspar than any other State, advancing from third place in 1937. As

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recently as 1928, no spar was ground in South Dakota. Colorado was second in output, followed by North Carolina and Tennessee. Ground spar produced by Tennessee and North Carolina together totaled 61,467 short tons in 1938, 32 percent less than in 1937. Production in South Dakota in 1938 reached 42,489 tons, an all-time record for the State; and that in Colorado declined to 33,529 tons, a 23-percent decrease. Arizona, whose output may not be published, was the only State other than South Dakota that increased production over 1937. New Jersey's output declined 5 percent to 13,901 short tons. Other States reported sizable decreases in 1938 compared with 1937.

*Ground feldspar sold by merchant mills [1] in the United States, 1934–38*

| Year | Number of active mills | Domestic | | | Canadian | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | Short tons | Value | | Short tons | Value | | Short tons | Value |
| | | | Total | Average | | Total | Average | | |
| 1934 | 26 | 136,820 | $1,731,528 | $12.66 | 7,358 | $136,972 | $18.62 | 144,178 | $1,868,500 |
| 1935 | 29 | 189,289 | 2,460,073 | 13.00 | 10,806 | 199,067 | 18.42 | 200,095 | 2,659,140 |
| 1936 | 30 | 222,126 | 2,884,493 | 12.99 | 14,764 | 270,360 | 18.31 | 236,890 | 3,154,853 |
| 1937 | 31 | 263,387 | 3,187,185 | 12.10 | 15,885 | 299,556 | 18.86 | 279,272 | 3,486,741 |
| 1938 | 30 | 206,646 | 2,314,675 | 11.20 | 7,868 | 151,577 | 19.26 | 214,514 | 2,466,252 |

[1] Excludes potters or others who grind for consumption in their own plants.

*Ground feldspar sold by merchant mills [1] in the United States, 1936–38, by States*

| State | 1936 | | | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Active mills | Short tons | Value | Active mills | Short tons | Value | Active mills | Short tons | Value |
| Arizona | 1 | (2) | (2) | 1 | (2) | (2) | 1 | (2) | (2) |
| California | 3 | 4,189 | $68,461 | 3 | 1,888 | $30,427 | 3 | 1,263 | $17,561 |
| Colorado | 1 | 28,034 | 206,550 | 2 | 43,618 | 307,412 | 2 | 33,529 | 219,699 |
| Illinois | 2 | (2) | (2) | 1 | (2) | (2) | 1 | (2) | (2) |
| Maine | 3 | 17,293 | 253,258 | 4 | 22,090 | 303,449 | 4 | 15,651 | 196,460 |
| Minnesota | 1 | (2) | (2) | 1 | (2) | (2) | 1 | (2) | (2) |
| New Hampshire | 2 | (2) | (2) | 2 | (2) | (2) | 2 | (2) | (2) |
| New Jersey | 3 | 14,430 | 286,940 | 3 | 14,700 | 287,577 | 3 | 13,901 | 258,123 |
| New York | 4 | (2) | (2) | 4 | (2) | (2) | 4 | (2) | (2) |
| Ohio | 2 | (2) | (2) | 2 | (2) | (2) | 1 | (2) | (2) |
| North Carolina | 3 | 85,240 | 1,153,466 | 3 | 90,696 | 1,239,149 | 3 | 61,467 | 821,686 |
| Tennessee | 2 | | | 2 | | | 2 | | |
| South Dakota | 2 | 26,486 | 255,888 | 2 | 40,325 | 316,834 | 2 | 42,489 | 300,192 |
| Virginia | 1 | (2) | (2) | 1 | 15,609 | 229,295 | 1 | 8,940 | 117,874 |
| Undistributed | | 61,218 | 930,290 | | 50,346 | 772,598 | | 37,274 | 534,657 |
| | 30 | 236,890 | 3,154,853 | 31 | 279,272 | 3,486,741 | 30 | 214,514 | 2,466,252 |

[1] Excludes potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."

The average value per short ton of ground feldspar produced by merchant mills in 1938 fell to $11.50, the lowest figure for many years, and ranged from $6.55 to $21.09 per ton in the various States. Sales realizations for Colorado and South Dakota in 1938 were respectively $6.55 and $7.07 compared with average values in the Eastern States as follows: New Jersey, $18.57; Tennessee-North Carolina, $13.37; Maine, $12.55; and Virginia, $13.19. Sales of ground feldspar manufactured from Canadian crude in 1938 averaged $19.26 per short ton compared with $18.86 per ton in 1937.

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Feldspar grinding mills in the United States are listed below:

*Feldspar grinders in the United States*

| *Name and address of grinder* | *Location of mill* |
|---|---|
| ARIZONA: | |
| Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J. | Kingman. |
| CALIFORNIA: | |
| Chamberlain Co., Inc., 2550 East Olympic Blvd., Los Angeles. | Los Angeles. |
| Gladding, McBean & Co., 1919 East 52d St., Los Angeles | Do. |
| Industrial Minerals & Chemical Co., 6th and Gilman Sts., Berkeley. | Berkeley. |
| Standard Sanitary Mfg. Co., Pacific Mines, Campo | Campo. |
| COLORADO: | |
| Colorado Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J. | Canon City. |
| Western Feldspar Milling Co., 1333 W. Maple Ave., Denver | Denver. |
| ILLINOIS: | |
| Abingdon Sanitary Mfg. Co., Abingdon | Abingdon. |
| MAINE: | |
| Ceramic Feldspar Co., Bath | Bath. |
| Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J. | Topsham. |
| Oxford Mining & Milling Co., West Paris | West Paris. |
| Topsham Feldspar Co., Brunswick | Cathance. |
| MINNESOTA: | |
| Feldspar Products Co., Warroad | Warroad. |
| NEW HAMPSHIRE: | |
| Golding-Keene Co., 29 Ralston St., Keene | Keene. |
| Seaboard Minerals Corporation, 52 William St., New York, N. Y. | Cold River. |
| NEW JERSEY: | |
| Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton. | Trenton. |
| Eureka Flint & Spar Co., Inc., New York Ave., Trenton | Do. |
| Standard Flint & Spar Corporation, 1401 New York Ave., Trenton. | Do. |
| NEW YORK: | |
| Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J. | Bedford and Rochester. |
| Genesee Feldspar Co., Inc., 360 Boxart St., Rochester | Rochester. |
| White Hill Mineral Co., Inc., Gouverneur | DeKalb. |
| NORTH CAROLINA: | |
| Feldspar Milling Co., Inc., Burnsville | Bowditch. |
| Southern Feldspar, Inc., Toecane | Toecane. |
| Tennessee Mineral Products Corporation, Spruce Pine | Spruce Pine. |
| OHIO: | |
| Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J. | East Liverpool. |
| SOUTH DAKOTA: | |
| Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J. | Keystone. |
| F. E. Schundler Feldspar Co., Custer | Custer. |

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*Feldspar grinders in the United States*—Continued

| Name and address of grinder | Location of mill |
|---|---|
| TENNESSEE: | |
| Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J. | Erwin. |
| North Carolina Feldspar Corporation, Erwin | Do. |
| VIRGINIA: | |
| Seaboard Feldspar Co., Hearst Tower Bldg., Baltimore, Md. | Brookneal. |
| Virginia Feldspar Co., Bedford | Bedford. |

## CONSUMPTION AND USES

Although the bulk of the crude spar produced is processed by merchant mills, two sanitary-products manufacturers have their own quarries and milling equipment. A few miners of crude spar sell all or part of their higher-grade product in the crude state to soap and cleanser manufacturers, who use it after grinding as a mild abrasive in their products.

As heretofore, by far the larger part of the output of ground feldspar was consumed in the glass, pottery, and enamel industries. In 1938 glass manufacturers used 55 percent of the feldspar produced, pottery lines about 35 percent, and the enamel trades about 9 percent. The small remainder was used for miscellaneous purposes, chiefly ceramic.

*Ground feldspar sold by merchant mills in the United States, 1936–38, by uses, in short tons*

| Use | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Percent of total | Short tons | Percent of total | Short tons | Percent of total |
| Ceramic: [1] | | | | | | |
| Glass | 121,677 | 51.4 | 142,028 | 50.9 | 117,800 | 54.9 |
| Pottery | 76,527 | 32.3 | [1] 102,346 | 36.6 | [1] 74,035 | 34.5 |
| Enamel and sanitary ware | 23,746 | 10.0 | [1] 25,111 | 9.0 | [1] 19,395 | 9.0 |
| Insulators and other porcelain goods | 5,105 | 2.1 | (1) | | (1) | |
| Brick and tile | 6,074 | 2.6 | (1) | | (1) | |
| Other ceramic uses | 1,839 | .8 | [1] 6,442 | 2.3 | [1] 2,077 | 1.0 |
| Soaps and abrasives | 1,328 | .8 | 1,653 | 1.2 | 1,207 | .6 |
| Binder for abrasive wheels | 584 | | 242 | | | |
| Other uses | 10 | | 1,450 | | | |
| | 236,890 | 100.0 | 279,272 | 100.0 | 214,514 | 100.0 |

[1] New classification for ceramic uses adopted in 1937 was as follows: Glass, pottery, enamel, and other ceramic. Except for glass, figures for 1937–38 are not directly comparable with those for earlier years.

All outlets for feldspar reduced their requirements in 1938. This slackening of demand is indicated by the 18-percent drop in production of glass containers in 1938 and the even greater decrease in output of plate and window glass. Output of porcelain-enameled flatware and sales of electric ranges and electric refrigerators for household use dropped sharply from 1937 levels. Production of bathroom accessories declined moderately.

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## TECHNOLOGIC DEVELOPMENTS

In the earlier years of the feldspar industry neither producers nor consumers paid much attention to exact specifications, but as the ceramic and glass industries began to insist upon rigid chemical control of batch ingredients definite standards were developed for alumina, lime, and alkali content, as well as stricter limits for iron.

To meet these conditions the feldspar mills were remodeled; laboratory control was introduced, and arrangements were made for stocking different grades of spar and blending them into products of known and guaranteed composition. Almost before the industry had put its house in order, however, competition arose from other mineral products heretofore not on the market. These new materials, particularly nepheline syenite from Canada and, later, "aplite" from Virginia, were developed largely through the search for fluxes of higher alumina content for use chiefly in the glass industry. Increased consumption of talc and pyrophyllite in the manufacture of whiteware bodies and other ceramic products likewise has affected the use of feldspar.

Magnetic separators have been installed in the larger mills to insure a low-iron product. Other processing methods long employed in ore dressing are being adapted to beneficiate nonmetallic minerals. Froth flotation, in particular, is well suited to the purification of feldspar, quartz, clay, talc, nephelite, spodumene, and other ceramic raw materials. Cationic reagents, such as certain substituted ammonium compounds and nitrogen bases, seem especially useful in selectively filming acidic minerals including quartz, feldspar, mica, or other silicates.

Allied to froth flotation in principle but radically different in nature of equipment is agglomerate tabling. In this process, which successfully treats much coarser sizes than can be handled by flotation, the separation is made on a shaking table. The selectively oiled particles agglomerate into loosely adherent balls which are rolled across the riffled surface regardless of specific gravity. A quartz-feldspar mine at Keene, N. H., is using this method and is reported to obtain a feldspar containing less than 2 percent impurities and virtually pure quartz as a byproduct.

The use of highly selective methods allows separation of both soda and potash feldspars from the quartz.[1] For this operation the cationic reagents previously employed in Bureau of Mines research on nonmetallic mineral separations are supplemented by a newly discovered activator.

Electrostatic separation has been improved to afford another potentially commercial means of removing impurities from feldspar. Better methods of beneficiation and more efficient refining practice have made possible the treatment of lower-grade mixed feldspar-quartz rock and even the utilization of old dump material as a source of good feldspar. The making of clean, salable spar economically from previously worthless quarry waste, and even from granite, gneiss, or other relatively fine grained rock, is of major importance in the older feldspar-mining areas where the most-accessible pegmatite deposits

[1] O'Meara, R. G., Norman, J. E., and Hammond, W. B., Flotation and Agglomerate Separation of Quartz and Feldspar: Bull. Am. Ceram. Soc. (abs.), vol. 18, No. 4, April 1939, p. 127.



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have been worked out and where recent competition from western spar and substitute materials has been most severe.

Results of an extensive field survey of the feldspar deposits of eight Virginia counties were published by the Virginia Polytechnic Institute.[2] Details of processes for purifying feldspar by magnetic separation have been described recently.[3] Direct determination of sodium oxide in feldspar was effected by Koenig.[4] Shelton[5] and Meyer reported on the effect of the rate of heating on the glass phase and the physical properties of whiteware bodies.

Utilization of iron- and steel-plant slag in glassmaking batches is reported from India.[6] Orthoclase feldspar combined with the slag, it is stated, makes a glass suitable for the manufacture of transparent as well as opaque and black bottles, jars, floor tiles, roof tiles, and other products. The large percentages of potash give good brilliance, and chemical durability is satisfactory owing to the almost equal proportions of potash and soda. Costs are claimed to be reduced about 50 percent as a result of the use of slag as a batch ingredient.

A German patent[7] describes the separation of mica and feldspar from the gangue rocks by a flotation process in which carbolic acid or creosote oil, a higher aliphatic acid or a salt thereof, and a terpineol are used together as flotation agents.

The economic significance of the feldspar deposits of middle, eastern, and southern Europe was described and production and export statistics were given by Kirnbauer.[8]

*Nepheline syenite.*—Three mills in the United States are now processing nepheline syenite for use in glass manufacture. Two of them—the American Nepheline Corporation, Rochester, N. Y., a subsidiary of Canadian Nepheline, Ltd., and the New England Nepheline Co., Keene, N. H., affiliated with Golding-Keene Co.—were in operation in 1937. The Oxford Mining & Milling Co., West Paris, Maine, a subsidiary of the United Feldspar Corporation, began grinding nepheline later. Crude rock for these mills is imported from Canada, mostly from Blue Mountain, Peterborough County, central Ontario, and from the neighboring counties of Hastings and Haliburton. Spence[9] has described the mining in this region and the processing both at Lakefield, Ontario, and at Rochester.

In wall tile and floor tile, according to Koenig,[10] the greater refractoriness of certain American clays is offset by additions of nepheline syenite, owing to its active fluxing action. Nepheline also permits the making of satisfactory floor-tile bodies at lower temperatures.

[2] Dear, Paul S., Matthews, A. A. L., and Whittemore, John W., Investigation of Some Virginia Feldspars: Virginia Polytech. Inst. Eng. Exp. Sta. Bull. 35, December 1938, 48 pp.; Ceram. Abs., vol. 18, No. 3, March 1939, p. 85.

[3] Feldspathic Research Corporation, C. H. Peddrick, Jr., and J. H. Weis, Feldspar: Canadian Patent 369,922, Nov. 16, 1937; Chem. Abs., vol. 32, No. 6, Mar. 20, 1938, p. 2308.

[4] Koenig, E. W., Direct Determination of Sodium Oxide in Feldspar: Jour. Am. Ceram. Soc., vol. 22, No. 1, January 1939, pp. 24–31.

[5] Shelton, G. R., and Meyer, W. W., Nature of the Glass Phase in Heated Clay Materials: Jour. Am. Ceram. Soc., vol. 21, No. 11, November 1938, pp. 371–385.

[6] Varshney, V. P., Science and Culture: Vol. 4, No. 1, 1938, pp. 45–47: Ind. and Eng. Chem., News Ed., vol. 16, No. 23, Dec 10, 1938, p. 640.

[7] Chemische Werke Schonebeck A. G. et al., G. Gerth., Separating Mica and Feldspar: German Patent 654,032, Dec. 9, 1937; Chem. Abs., vol. 32, No. 6, Mar. 20, 1938, p. 2302–2303.

[8] Kirnbauer, F., Productive Feldspar and Kaolin Deposits in Middle, East, and South Europe and Their Economic Importance: Berg-u. Hüttenmänn. Jahrb. Montan. Hochschule Leoben, vol. 85, Nos. 3–4, 1937, pp. 291–297; Ceram. Abs., vol. 17, No. 5, May 1938, p. 197.

[9] Spence, Hugh S., Nepheline Syenite: A New Ceramic Raw Material from Ontario: Am. Inst. Min. and Met. Eng., Tech. Pub. 951, New York, 1938, 9 pp.

[10] Koenig, C. J., Use of Nepheline Syenite in Floor- and Wall-Tile Bodies: Bull. Am. Ceram. Soc., vol. 18, No. 4, April 1939, p. 138.

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Crude nepheline syenite is bound free of duty in the Reciprocal Trade Agreement with Canada. There is a reservation, however, that if the imports of crude and ground material combined in any year exceed 50,000 tons the Canadian and the United States Governments will consult on measures to be taken. If no agreement is reached the United States reserves the right to impose a customs duty on imports in excess of the 50,000 tons stipulated. For the ground product this charge would be in addition to the present duty, which was reduced from 30 to 15 percent by the agreement.

*Aplite.*—In November 1938 another new high-alumina ceramic flux was made available to glass and pottery manufacturers. This material, known as aplite, which occurs near Piney River, Amherst County, Va., is a highly altered, white, massive rock consisting of albite and microcline feldspars, sericite, zoisite, clinozoisite, and other minerals. A typical analysis shows 59.80 percent $SiO_2$, 0.397 percent $Fe_2O_3$, 24.29 percent $Al_2O_3$, 5.86 percent CaO, 5.82 percent $Na_2O$, and 2.67 percent $K_2O$. Even with magnetic separators the iron content cannot readily be reduced below about 0.2 or 0.3 percent, which bars its use in clear-glass products but not in colored-glass containers, such as milk, liquor, and cosmetic bottles and similar glassware. The deposit, which apparently is quite extensive, is being developed by Dominion Minerals, Inc. Chemical and mineralogical content and physical properties of the rock were described in detail and the possibilities of its use for various ceramic purposes discussed by Dear and Whittemore.[11]

At the present stage of operation, until its iron content can be reduced further, aplite can be used in clear glass or white pottery only as a supplement to, rather than as a substitute for, feldspar. A blend of aplite and feldspar carries more alumina than the average commercial feldspar, but the proportion of aplite is limited strictly by the permissible iron content. Aplite, however, is cheaper than feldspar because it can be quarried by ordinary methods as it occurs in massive formations rather than in irregulr pockets in pegmatite veins or lenses.

*Volcanic ash.*—Further encroachment upon markets now supplied largely by feldspar is foreshadowed by recent tests of volcanic ash as a glaze constituent in glass batches. Plummer [12] reported the successful use of volcanic ash or pumicite in both fritted and raw glazes to replace the feldspar and part of the flint. Although in some of the glazes tested the ash content was more than 50 percent of the batch and the maturing temperature ranged from cones 09 to 8, no significant difference could be detected between the volcanic-ash glazes and control glazes of nearly identical chemical composition except the color effects due to the higher iron content of the pumicite.

The finely divided nature of the ash in its raw untreated state and its low cost, about $2 a ton, f. o. b., would be important factors in its possible utilization in glass batches and in colored glazes for roofing tile, wall tile, and low-priced pottery. About 1½ parts of the ash are said to be equivalent to 1 part of feldspar. Abundant supplies of nonweathered ash are available in southwest Kansas and northwest Oklahoma, particularly in McPherson County, Kans., and near Gate,

[11] Dear, P. S., and Whittemore, J. W., Aplite, A New Ceramic Material: Bull. Am. Ceram. Soc. (abs.), vol. 18, No. 4, April 1939, p. 138.

[12] Plummer, Norman, Ceramic Uses of Volcanic Ash: Bull. Am. Ceram. Soc., vol. 18, No. 1, January 1939, pp. 8–11.

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Okla. K. K. Landes, [13] assistant State geologist of Kansas, at Lawrence, recently has devoted much time and energy to the adaptation of volcanic ash to industrial use. Other selected references [14] may be of interest.

## FOREIGN TRADE

Effective January 1, 1939, under the Reciprocal Trade Agreement with Canada—virtually the only source of feldspar imports into the United States—the duty on crude spar was reduced to 25 cents a ton and that on ground spar to 15 percent. The rate on crude spar as specified in paragraph 207 of the Tariff Act of 1930 was $1 a long ton but was cut to 50 cents on January 1, 1932, by Presidential proclamation and to 35 cents under the first Canadian Trade Agreement. The latest 10-cent reduction brings the rate to only one-fourth of that provided in the Tariff Act of 1930 when the material was removed from the free list. Simultaneously, the Canadian duty on ground feldspar imported from the United States was lowered from 20 to 15 percent—the same rate as that levied on imports into the United States.

*Imports.*[15]—Both the tonnage and value of imports for consumption of crude feldspar in 1938, all from Canada, decreased approximately 40 percent—to 7,652 long tons worth $56,133 from 12,956 tons worth $91,885 in 1937. The average value per ton (foreign market value), however, increased to $7.34 in 1938 from $7.09 in 1937. In 1938, as in 1937, no ground feldspar was imported.

*Feldspar imported for consumption in the United States, 1934–38*

| Year | Crude | | Ground | | Year | Crude | | Ground | |
|---|---|---|---|---|---|---|---|---|---|
| | Long tons | Value | Short tons | Value | | Long tons | Value | Short tons | Value |
| 1934 | 9,744 | $67,258 | ------- | ------- | 1937 | 12,956 | $91,885 | ------- | ------- |
| 1935 | 8,937 | 56,175 | 1 | $106 | 1938 | 7,652 | 56,133 | ------- | ------- |
| 1936 | 10,786 | 68,198 | 132 | 1,276 | | | | | |

Probably owing to the increased use of natural or artificially blended materials of domestic origin, receipts of Cornwall stone receded sharply in 1938. Imports of the manufactured stone dropped to 513 long tons valued at $4,976, from 1,899 tons valued at $16,864 in 1937. Imports of ground Cornwall stone also decreased, amounting to 233 long tons valued at $1,797 compared with 323 tons valued at $4,267 in 1937. Crude and ground material originated in the United Kingdom in both 1937 and 1938.

[13] Landes, K. K., Distribution of Volcanic Ash: Paper presented at 40th Ann. Meeting, Am. Ceram. Soc. New Orleans, Mar. 28, 1938.

[14] Moore, B. N., Pumice and Pumicite: Am. Inst. Min. and Met. Eng., Industrial Minerals and Rocks, New York, 1937, p. 601–607.

———, Nonmetallic Mineral Resources of Eastern Oregon: Geol. Survey, Bull. 875, 1937, 180 pp.

Singleton-Greene, G., Pumice as an Aggregate in Concrete: Sands, Clays, and Minerals, vol. 3, No. 2, 1937. pp. 109–112.

Baker, C. L., Volcanic Ash in Texas: Univ. Texas Bureau Econ. Geol., Mineral Resources Circ. 2, December 1931.

Preston, F. W., Volcanic Ash as a Constituent of Glass Batches: Glass Ind., vol. 16, No. 4, 1935, p. 111; Ceram. Abs. vol. 14, No. 6, 1935, p. 138.

[15] Figures on imports compiled by M. B. Price, of the Bureau of mines, from records of the Bureau of Foreign and Domestic Commerce.

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## WORLD PRODUCTION

Sweden, Norway, China, and probably Czechoslovakia are the chief producers of feldspar aside from the United States. Smaller outputs regularly come from Germany (Bavaria), Italy, Rumania, Finland, Australia, and other widely separated countries. A large part of the Canadian crude-spar production is shipped to grinding mills in the United States for processing.

Available figures on world production of feldspar, 1934 to 1938, inclusive, follow.

*World production of feldspar, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Argentina (shipments) | 431 | 495 | 1,082 | (2) | (2) |
| Australia: | | | | | |
| New South Wales [3] | 891 | 166 | 101 | 162 | (2) |
| South Australia [3] | 212 | 315 | 553 | 669 | (2) |
| Western Australia (exports) | 1,845 | 2,703 | 3,047 | 3,031 | (2) |
| Brazil | (2) | (2) | (2) | 8,400 | (2) |
| Canada (shipments) | 16,603 | 16,095 | 16,190 | 19,365 | 12,817 |
| China [4] | 27,780 | (2) | (2) | (2) | (2) |
| Egypt | | 72 | 45 | 158 | (2) |
| Finland (exports) | 3,329 | 2,071 | 2,520 | 3,232 | (2) |
| France | | | | 8,900 | (2) |
| Germany (Bavaria) | 6,808 | 6,337 | 9,524 | 9,986 | (2) |
| India, British | 638 | 713 | 798 | 495 | (2) |
| Italy | 7,637 | 7,616 | 8,620 | 13,437 | (2) |
| Norway (exports) | 22,139 | 24,228 | 29,985 | 32,555 | 21,761 |
| Rumania | 1,026 | 14,180 | 1,960 | (2) | (2) |
| Sweden | 34,468 | 48,637 | 56,799 | 49,140 | (2) |
| United States (sold or used) | 156,663 | 192,592 | 248,654 | 272,842 | 199,267 |

[1] In addition to countries listed, feldspar is produced in Czechoslovakia. Official figures of output are not available, but it is estimated that the annual production is approximately 30,000 metric tons. (Stat. Comm. Czechoslovak Ceram. Soc.)

[2] Data not yet available.

[3] Includes some china stone.

[4] Includes Manchuria.

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# ASBESTOS

By Oliver Bowles and K. G. Warner

## SUMMARY OUTLINE


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| Prices | 1312 | | |


Asbestos may be termed indispensable to modern life. As the chief constituent of brake-band linings and clutch facings it is essential to automotive transport; in the form of gaskets and packings it is a necessary part of steam-driven machinery; as a heat insulator it plays an important role in both household and factory construction and equipment; and combined with cement it is employed in the manufacture of vast quantities of roofing and other building materials.

The United States is the largest asbestos-consuming country in the world but produces only a small fraction of its requirements of raw materials. In 1938 domestic sales amounted to 6 percent of the quantity and 4 percent of the value of domestic requirements. How could our needs be met in an emergency?

Stimulation of domestic production bears little promise. Although many occurrences of chrysotile asbestos have been noted in the United States, few seem to have commercial possibilities. Arizona deposits furnish excellent crude fiber; but mining costs are high, transportation difficult, and freight rates to eastern markets excessive. Although Vermont deposits are extensive and can produce large quantities of mill fibers of moderate to short lengths, they furnish little fiber of spinning grade. Chrysotile deposits are known in California and some other States, but none appear to be capable of development into consistent producers.

The possibility of making synthetic asbestos to take the place of the natural fiber has been suggested; but, because of the special qualities of high-grade fiber that man cannot duplicate in a laboratory, the manufacture of a satisfactory product seems to be farther from attainment than the manufacture of synthetic diamonds.

Another alternative is substitution of other materials for the major uses of asbestos. Some progress has been made in this direction. Synthetic fibers such as mineral wool, slag wool, and glass wool, now made in large quantities, are related in no way to asbestos in composition yet have physical qualities that permit their employment in some fields of usefulness wherein asbestos has heretofore been used exclusively. In the heat-insulation field particularly the mineral-wool fibers have made some headway, but until it is demonstrated that they can be adapted to the other major uses the United States evi-



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dently must continue to depend on foreign sources for its major supplies of asbestos.

The following table of salient statistics shows that domestic production in 1938 was 7 percent lower than in 1937. Asbestos sold or used by producers in 1938 decreased 14 percent in quantity and 28 percent in value compared with 1937. The large decline in unit value was due primarily to sales of an unusually high proportion of the shorter fibers produced in Arizona—a favorable development because heretofore sales have been confined principally to crudes on account of the high cost of transportation. With a well-equipped mill now catering particularly to the west-coast trade in shorter fibers, producers are provided with an avenue for sale of the lower-grade fibers that formerly were left on their hands. Compared with 1937, apparent consumption in the United States in 1938 dropped 41 percent in quantity and 42 percent in value.

*Salient statistics of the asbestos industry in the United States, 1937–38*

| | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Domestic asbestos— | | | | |
| Produced: | | | | |
| Chrysotile | 13,284 | [1] | [2] | [1] |
| Amphibole | 612 | [1] | [2] | [1] |
| Total produced | 13,896 | [1] | 12,901 | [1] |
| Sold or used by producers: | | | | |
| Chrysotile | 11,547 | $332,747 | [2] | [2] |
| Amphibole | 532 | 11,897 | [2] | [2] |
| Total sold or used by producers | 12,079 | 344,644 | 10,440 | $247,264 |
| Imports (unmanufactured) | 307,188 | 10,470,208 | 179,490 | 6,160,602 |
| Exports (unmanufactured) | 3,004 | 253,734 | 2,780 | 288,617 |
| Apparent consumption [3] | 316,263 | 10,561,118 | 187,150 | 6,119,249 |
| Exports of asbestos products | [1] | 3,047,078 | [1] | 2,533,916 |

[1] Figures not available.
[2] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.
[3] Quantity sold or used by producers, plus imports, minus exports.

Because of the interest that has lately been centered on strategic and critical minerals from a military standpoint and the fact that asbestos has been classed by the Army and Navy Munitions Board as a critical mineral, it seems fitting at this time to present a historic table comprising data on production and consumption for virtually half a century. Prior to 1890, the first year recorded in the table, asbestos had little industrial importance.

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*Asbestos sold or used by producers and apparent consumption in the United States, 1890–1938*

| Year | Sold or used by producers | | | | | | Apparent consumption [1] | |
|---|---|---|---|---|---|---|---|---|
| | Chrysotile | | Amphibole | | Total | | | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1890 | | | 71 | $4,560 | 71 | $4,560 | (2) | [3] $257,117 |
| 1891 | | | 66 | 3,960 | 66 | 3,960 | (2) | [3] 357,549 |
| 1892 | 10 | $793 | 94 | 5,623 | 104 | 6,416 | (2) | [3] 268,849 |
| 1893 | | | 50 | 2,500 | 50 | 2,500 | (2) | [3] 178,102 |
| 1894 | | | 325 | 4,463 | 325 | 4,463 | (2) | [3] 244,492 |
| 1895 | (4) | (4) | (4) | (4) | 795 | 13,525 | (2) | [3] 238,672 |
| 1896 | | | 504 | 6,100 | 504 | 6,100 | (2) | [3] 235,184 |
| 1897 | (4) | (4) | (4) | (4) | 580 | 6,450 | (2) | [3] 270,090 |
| 1898 | (4) | (4) | (4) | (4) | 605 | 10,300 | (2) | [3] 297,936 |
| 1899 | (4) | (4) | (4) | (4) | 681 | 11,740 | (2) | [3] 314,859 |
| 1900 | (4) | (4) | (4) | (4) | 1,054 | 16,310 | (2) | [3] 348,106 |
| 1901 | (4) | (4) | (4) | (4) | 747 | 13,498 | (2) | [3] 680,585 |
| 1902 | | | 1,005 | 16,200 | 1,005 | 16,200 | (2) | [3] 745,621 |
| 1903 | (4) | (4) | (4) | (4) | 887 | 16,760 | (2) | [3] 674,029 |
| 1904 | | | 1,480 | 25,740 | 1,480 | 25,740 | (2) | [3] 726,312 |
| 1905 | 114 | 4,615 | 2,995 | 38,360 | 3,109 | 42,975 | (2) | [3] 819,337 |
| 1906 | 155 | (5) | 1,540 | (5) | 1,695 | 28,565 | (2) | [3] 1,039,019 |
| 1907 | | | 653 | 11,899 | 653 | 11,899 | (2) | [3] 1,116,008 |
| 1908 | (4) | (4) | (4) | (4) | 936 | 19,624 | (2) | [3] 1,087,946 |
| 1909 | (4) | (4) | (4) | (4) | 3,085 | 62,603 | (2) | [3] 1,055,857 |
| 1910 | (4) | (4) | (4) | (4) | 3,693 | 68,357 | (2) | [3] 1,303,527 |
| 1911 | (4) | (4) | (4) | (4) | 7,604 | 119,935 | (2) | [3] 1,533,476 |
| 1912 | (4) | (4) | (4) | (4) | 4,403 | 87,959 | (2) | [3] 1,543,971 |
| 1913 | | | 1,100 | 11,000 | 1,100 | 11,000 | [3] 98,169 | [3] 1,939,705 |
| 1914 | 22 | 5,450 | 1,225 | 13,515 | 1,247 | 18,965 | (2) | [3] 1,426,719 |
| 1915 | 316 | 65,148 | 1,415 | 11,804 | 1,731 | 76,952 | [3] 95,298 | [3] 2,058,435 |
| 1916 | 808 | 167,683 | 830 | 13,311 | 1,638 | 180,994 | [6] 117,488 | [6] 3,478,331 |
| 1917 | 1,391 | 279,270 | 567 | 11,744 | 1,958 | 291,014 | 135,338 | 4,695,606 |
| 1918 | 392 | 101,059 | 606 | 17,628 | 998 | 118,687 | 138,001 | 6,405,242 |
| 1919 | 502 | 229,265 | 659 | 19,000 | 1,161 | 248,265 | 135,312 | 7,460,534 |
| 1920 | 1,245 | 661,907 | 403 | 16,324 | 1,648 | 678,231 | 168,591 | 9,657,413 |
| 1921 | 438 | 313,268 | 393 | 23,700 | 831 | 336,968 | 72,774 | 3,183,670 |
| 1922 | 25 | 3,320 | 42 | 6,800 | 67 | 10,120 | 149,118 | 5,104,881 |
| 1923 | 69 | 4,433 | 158 | 5,193 | 227 | 9,626 | 211,967 | 7,406,244 |
| 1924 | 173 | 33,941 | 127 | 8,585 | 300 | 42,526 | 182,280 | 5,552,308 |
| 1925 | 93 | 40,750 | 1,165 | 10,950 | 1,258 | 51,700 | 230,669 | 7,115,156 |
| 1926 | (4) | (4) | (4) | (4) | 1,358 | 134,731 | 257,875 | 8,191,314 |
| 1927 | (4) | (4) | (4) | (4) | 2,981 | 336,882 | 226,365 | 8,438,448 |
| 1928 | (4) | (4) | (4) | (4) | 2,239 | 351,178 | 231,984 | 9,022,437 |
| 1929 | 1,983 | 317,584 | 1,172 | 33,420 | 3,155 | 351,004 | 264,873 | 11,395,554 |
| 1930 | 3,653 | 273,292 | 589 | 15,992 | 4,242 | 289,284 | 212,152 | 7,258,790 |
| 1931 | 2,857 | 111,708 | 371 | 7,259 | 3,228 | 118,967 | 137,875 | 3,745,916 |
| 1932 | (4) | (4) | (4) | (4) | 3,559 | 105,292 | 98,606 | 2,260,556 |
| 1933 | (4) | (4) | (4) | (4) | 4,745 | 130,677 | 122,909 | 3,584,639 |
| 1934 | (4) | (4) | (4) | (4) | 5,087 | 158,347 | 123,752 | 3,442,159 |
| 1935 | (4) | (4) | (4) | (4) | 8,920 | 292,927 | 174,655 | 5,330,444 |
| 1936 | 10,719 | 302,301 | 345 | 11,860 | 11,064 | 314,161 | 250,922 | 7,528,901 |
| 1937 | 11,547 | 332,747 | 532 | 11,897 | 12,079 | 344,644 | 316,263 | 10,561,118 |
| 1938 | (4) | (4) | (4) | (4) | 10,440 | 247,264 | 187,150 | 6,119,249 |

[1] Quantity sold or used by producers, plus imports, minus exports, except as indicated.
[2] Data on quantity of asbestos imported not available 1890–1912 and 1914.
[3] Asbestos sold or used by producers, plus imports; data on exports not separately recorded prior to July 1916.
[4] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.
[5] Figures not available.
[6] Export figures cover period July to December 1916.

*Consumption trends.*—The following table shows trends in the asbestos-products industries of the United States during recent years. The volume of asbestos consumed depends primarily on two great industries—automobile manufacture and the building trades. Although asbestos consumption made remarkable gains in 1937, outstripping both these consuming industries, the reversal in trend in 1938 was just as pronounced. As indicated in figure 1, only about

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half as many automobiles were manufactured in 1938 as in 1937, and the moderate gain in building contracts failed to stem the downward trend in asbestos consumption that virtually paralleled the decline in output of automobiles.

*Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1933–38*

| Year | Raw asbestos—apparent consumption | Asbestos products— | | Year | Raw asbestos—apparent consumption | Asbestos products— | |
|---|---|---|---|---|---|---|---|
| | | Manufactured [1] | Exported [2] | | | Manufactured [1] | Exported [2] |
| | *Short tons* | | | | *Short tons* | | |
| 1933 | 122,909 | $44,644,270 | $1,743,140 | 1936 | 250,922 | (1) | $2,479,273 |
| 1934 | 123,752 | (1) | 2,142,514 | 1937 | 316,263 | $96,347,570 | 3,047,078 |
| 1935 | 174,655 | 62,420,944 | 2,261,929 | 1938 | 187,150 | (1) | 2,533,916 |

[1] Figures of Bureau of the Census (collected biennially for odd years) include value of certain gaskets, packing, and similar products in which little asbestos was employed.
[2] Compiled from the records of the Bureau of Foreign and Domestic Commerce.

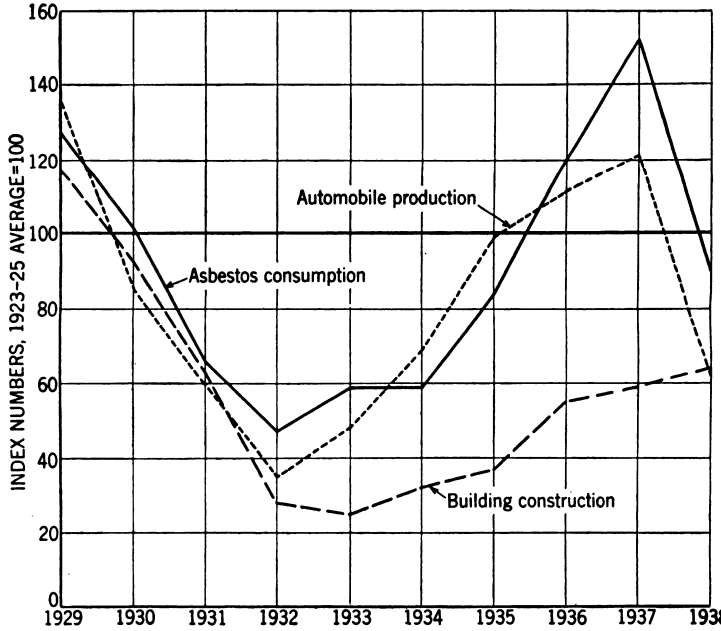


FIGURE 1.—Asbestos consumption compared with automobile production and value of building construction, 1929–38. Unlike units are reduced to percentages of the 1923–25 average. Statistics on automobiles are from the Bureau of the Census and building contracts from the Federal Reserve Board.

*Market conditions.*—The demand for asbestos in the United States was weak and hesitant throughout most of the year, although there was some evidence of improvement in November and December. European and Japanese markets were more active than those in America.

*Prices.*—All prices for asbestos are quoted on a short-ton basis. Canadian prices are f. o. b. Quebec mines, tax and bags included; Rhodesian, South African, and Russian, c. i. f. New York; and Vermont prices, f. o. b. mines, Vermont.

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According to quotations in Metal and Mineral Markets, published by the McGraw-Hill Publishing Co., Inc., New York City, prices of Canadian asbestos were as follows: Crude No. 1, $700–$750; Crude No. 2 and sundry crudes, $150–$350; spinning fibers, magnesia, and compressed sheet fibers, $110–$200; shingle stock, $57–$77 ($78 in December); paper stock, $40–$45; cement stock, $21–$25; floats, $18–$20; and shorts, $12–$16.50.

Rhodesian Crude No. 1 was quoted at $275 and Crude No. 2 at $250 until March, when the prices were advanced to $300 and $260, respectively.

South African prices quoted since March 1938 are as follows: Amosite: Grade B 1 (white), $140; Grade B 3 (dark), $120. Transvaal Blue: Grade B (long fiber), $450; Grade S (short fiber), $140.

Russian Crude AA was quoted at $750; Crude No. 1, $275; Crude No. 2, $240; and shingle stock, $67.50 and up.

Vermont prices were constant throughout the year as follows: Shingle stock, $57; paper stock, $40; cement stock, $25; and shorts and floats, $12–$18.

## NEW DEVELOPMENTS

A decided increase in the use of molded brake linings in place of those made of asbestos fabric is to be noted. According to figures compiled by the Bureau of the Census, molded brake linings constituted 39 percent of the total footage in 1935 and 56 percent in 1937. One large manufacturer of asbestos products estimates that eventually molded linings may increase to more than 70 percent of the total. Recently a new type of die-formed molded lining made from woven fabric has been developed. Undoubtedly it has been devised by companies equipped for woven linings but desirous of entering the molded-lining field without discarding their present equipment.

A new type of cast pipe made of sulfur employs shredded asbestos as one of its constituents.

A sprayed coating for heat insulation, prevention of corrosion, and noise reduction consists of asbestos fibers and a bonding medium. These materials are projected against the surface in separate streams, and thus a feltlike coating is built up.

## REVIEW BY STATES

*Arizona.*—Both production and sales of chrysotile asbestos, chiefly from Gila County, made further gains in 1938. Sales were made by the Arizona Chrysotile Asbestos Co., Emsco Asbestos Co., and Arthur Enders, all of Globe, Ariz.; and Johns-Manville Products Corporation, New York, N. Y. Arthur Enders operates a mine on the Apache Reservation, under lease from the United States Government. According to report the fiberizing mill of the Emsco Asbestos Co. at Downey, Calif., has a capacity of 600 tons monthly.

*Maryland.*—The Powhatan Mining Corporation, Woodlawn, Baltimore, Md., produced amphibole asbestos near Pylesville, Harford County, and prepared it for use chiefly in filtering chemicals. For many years this material has been designated anthophyllite. Although some anthophyllite may be present in the deposit, the principal product has been identified definitely as tremolite.

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*Vermont.*—The name of the company operating the well-known property at Eden, Lamoille County, has been changed to Vermont Asbestos Mines, division of the Ruberoid Co. (address 500 Fifth Avenue, New York, N. Y.). This company is the largest producer of asbestos in the United States.

*Other States.*—Plans are being made to resume operations at the Morgan asbestos mine in Placer County, Calif., and also for developing a property 9 miles from Glenrock, Converse County, Wyo. It has been reported to the Bureau of Mines that the Karstolite Co. no longer operates the anthophyllite deposit in Gallatin County, Mont.; but a new company, the Montana Asbestos Co., is in process of organization.

## FOREIGN TRADE [1]

The following table shows imports of unmanufactured asbestos into the United States by countries and classes in 1937 and 1938. The total imports declined 42 percent in quantity and 41 percent in value. The decrease was shared by all countries furnishing substantial supplies except Italy, whose imports increased 59 percent. Imports from Cyprus fell from over 8,000 tons to an insignificant quantity.

*Asbestos (unmanufactured) imported for consumption in the United States, 1937–38, by countries and classes*

| Country | Crude (including blue fiber) | | Mill fibers | | Short fibers [1] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1937 | | | | | | | | |
| Africa, British: | | | | | | | | |
| Union of South Africa | 4,247 | $490,335 | | | 1 | $27 | 4,248 | $490,362 |
| Other British | 7,099 | 794,256 | | | | | 7,099 | 794,256 |
| Canada | 2,620 | 556,034 | 95,788 | $4,775,513 | 177,602 | 2,984,299 | 276,010 | 8,315,846 |
| Finland | | | | | 88 | 3,568 | 88 | 3,568 |
| France | | | | | 122 | 1,735 | 122 | 1,735 |
| Italy | 31 | 22,332 | | | 958 | 19,755 | 989 | 42,087 |
| Malta, Gozo, Cyprus | | | | | 8,129 | 310,058 | 8,129 | 310,058 |
| U. S. S. R. | 39 | 8,464 | 7,978 | 363,804 | 2,196 | 85,392 | 10,213 | 457,660 |
| United Kingdom | 290 | 54,636 | | | | | 290 | 54,636 |
| | 14,326 | 1,926,057 | 103,766 | 5,139,317 | 189,096 | 3,404,834 | 307,188 | 10,470,208 |
| 1938 | | | | | | | | |
| Africa: | | | | | | | | |
| Union of South Africa | 3,677 | 456,073 | | | | | 3,677 | 456,073 |
| Other British | 2,745 | 310,147 | | | | | 2,745 | 310,147 |
| Australia | 21 | 6,006 | | | | | 21 | 6,006 |
| Austria [2] | | | | | 3 | 142 | 3 | 142 |
| Canada | 1,360 | 321,424 | 51,141 | 2,701,494 | 113,570 | 2,043,844 | 166,071 | 5,066,762 |
| Finland | | | | | 89 | 3,564 | 89 | 3,564 |
| Italy | 18 | 12,477 | | | 1,551 | 38,488 | 1,569 | 50,965 |
| Malta, Gozo, Cyprus | | | | | 6 | 294 | 6 | 294 |
| U. S. S. R. | 1 | 479 | 5,201 | 258,593 | 63 | 1,525 | 5,265 | 260,597 |
| United Kingdom | 22 | 5,205 | | | 22 | 847 | 44 | 6,052 |
| | 7,844 | 1,111,811 | 56,342 | 2,960,087 | 115,304 | 2,088,704 | 179,490 | 6,160,602 |

[1] Asbestos, n. e. s., containing not over 15 percent of foreign matter.
[2] Figures cover period Jan. 1–May 5.

The following table shows imports and exports of unmanufactured asbestos for the 5-year period 1934–38:

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Asbestos (unmanufactured) imported for consumption in and exported from the United States, 1934–38*

| Year | Imports | | Exports | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| 1934 | 120,334 | $3,377,994 | 1,669 | $94,182 |
| 1935 | 166,585 | 5,125,413 | 850 | 87,896 |
| 1936 | 243,602 | 7,524,937 | 3,744 | 310,197 |
| 1937 | 307,188 | 10,470,208 | 3,004 | 253,734 |
| 1938 | 179,490 | 6,160,602 | 2,780 | 288,617 |

The following table shows exports of asbestos products in 1937 and 1938:

*Manufactured asbestos products exported from the United States, 1937–38, by kinds*

| Product | 1937 | | 1938 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| Brake lining: | | | | |
| Molded and semimolded | (1) | $722,075 | (1) | $608,970 |
| Not molded, linear feet | 1,633,558 | 250,955 | 923,672 | 176,765 |
| Clutch facing, number | 499,870 | 140,711 | 448,121 | 134,209 |
| Paper, millboard, and roll board, short tons | 869 | 183,610 | 725 | 100,034 |
| Pipe covering and cement, do | 2,384 | 197,000 | 1,143 | 128,666 |
| Textiles, yarn, and packing, do | 762 | 789,398 | 565 | 611,549 |
| Asbestos roofing, squares | 37,026 | 166,312 | 83,080 | 225,987 |
| Other asbestos manufactures, except roofing, short tons | 1,889 | 324,100 | 1,593 | 293,272 |
| Magnesia and manufactures, do | 1,567 | 272,917 | 1,601 | 254,464 |

[1] Quantity not recorded.

## WORLD PRODUCTION

The following table shows world production of asbestos, by countries, from 1934 to 1938, insofar as figures are available:

*World production of asbestos, 1934–38, by countries, in metric tons* [1]

[Compiled by M. T. Latus]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Argentina | ---------- | [2] 13 | ---------- | ---------- | (3) |
| Australia: | | | | | |
| South Australia | ---------- | 36 | 81 | 123 | (3) |
| Western Australia | 157 | 143 | 162 | 43 | (3) |
| Bolivia | ---------- | ---------- | (4) | 21 | 21 |
| Bulgaria | 3 | 3 | ---------- | ---------- | (3) |
| Canada [5] | 141,502 | 190,931 | 273,322 | 371,967 | 262,970 |
| China | 290 | (3) | (3) | (3) | (3) |
| Chosen | 4 | 6 | 69 | 70 | (3) |
| Cyprus [6] | 7,712 | 7,634 | 9,659 | 11,892 | 5,668 |
| Czechoslovakia | 2,100 | 2,600 | 2,700 | (3) | (3) |
| Finland | 1,735 | 1,742 | 3,963 | 3,330 | (3) |
| France | 400 | 450 | 405 | 250 | (3) |
| Greece | 30 | 2 | 1 | 2 | (3) |
| India, British | 25 | 64 | 57 | 102 | (3) |
| Indochina | ---------- | ---------- | 5 | 5 | (3) |
| Italy | 2,252 | 4,320 | 6,113 | 6,393 | (3) |
| Japan [7] | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Southern Rhodesia | 29,224 | 38,644 | 51,116 | 51,722 | 53,352 |
| Turkey | 4 | 104 | 119 | 157 | (3) |
| Union of South Africa | 15,960 | 20,600 | 22,894 | 25,975 | 21,025 |
| U. S. S. R. | 92,200 | 95,500 | 125,117 | (3) | (3) |
| United States (sold or used by producers) | 4,615 | 8,092 | 10,037 | 10,958 | 9,471 |
| Venezuela | ---------- | 76 | 71 | (3) | (3) |

[1] In addition to countries listed, a small quantity of asbestos is reported from Madagascar.
[2] Rail and river shipments.
[3] Data not available.
[4] Less than 1 ton.
[5] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1934, 4,238 tons; 1935, 2,744 tons; 1936, 2,815 tons; 1937, 3,611 tons; 1938, 2,975 tons.
[6] Exports.
[7] Approximate production.

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## CANADA

Sales of asbestos in Canada during 1938 declined 29 percent in quantity and 11 percent in value from the all-time high level of 1937. The entire production was from the Province of Quebec. The well-known deposits of this Province have been described in detail by Cooke.[2]

An improved all-metal standard testing machine recently devised retains the essential principle of the old machine.

In September 1938 it was reported that a new asbestos discovery had been made 260 miles north of North Bay, Ontario, but no details are available. Some publicity has been given to a new discovery on an island in Lake of the Woods, Ontario, but the material appears to be anthophyllite, which has little commercial importance at present. The following table shows sales in 1937 and 1938, as published in the Preliminary Report on the Mineral Production of Canada in 1938, issued by the Dominion Bureau of Statistics:

*Sales of asbestos in Canada, 1937–38*

| | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Short tons | Value | | Short tons | Value | |
| | | Total | Average per ton | | Total | Average per ton |
| Grade: | | | | | | |
| Crudes | 3,846 | $947,917 | $246.47 | 2,910 | $955,424 | $328.32 |
| Fibers | 200,247 | 10,235,820 | 51.12 | 163,182 | 9,714,509 | 59.53 |
| Shorts | 205,933 | 3,322,054 | 16.13 | 123,785 | 2,223,873 | 17.97 |
| | 410,026 | 14,505,791 | 35.38 | 289,877 | 12,893,806 | 44.48 |
| Sand, gravel, and stone (waste rock only) | 3,980 | 3,301 | .83 | 3,279 | 2,464 | .75 |
| Total asbestos and waste rock | 414,006 | 14,509,092 | | 293,156 | 12,896,270 | |
| Rock mined | 6,477,805 | | | 5,816,368 | | |
| Rock milled | 5,440,607 | | | 4,874,548 | | |

## AFRICA

*Southern Rhodesia.*—The output of asbestos in Southern Rhodesia in 1938 exceeded by 3 percent the record production of 1937. The following table shows production during recent years:

*Asbestos produced in Southern Rhodesia, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 32,214 | £402,745 | 1937 | 57,014 | £840,025 |
| 1935 | 42,598 | 646,658 | 1938 | 58,811 | 1,020,921 |
| 1936 | 56,346 | 836,469 | | | |

*Union of South Africa.*—The output in the Union of South Africa in 1938 dropped 19 percent below that of 1937. Natal has again become a producer in a small way. The following table shows production during recent years:

[2] Cooke, H. C., Thetford, Disraeli, and Eastern Half of Warwick Map-Areas, Quebec: Canada, Dept. of Mines and Resources, Geol. Survey, Mem. 211, 1937, pp. 86–140.

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*Asbestos produced in the Union of South Africa, 1934–38, by sources*

| Year | Short tons | | | | Total value |
|---|---|---|---|---|---|
| | Transvaal | Cape Province | Natal | Total | |
| 1934 | 14,783 | 2,810 | ---------- | 17,593 | £203,033 |
| 1935 | [1] 20,167 | [1] 2,541 | ---------- | 22,708 | [2] 226,167 |
| 1936 | 21,188 | 4,048 | ([3]) | [2] 25,236 | [2] 337,229 |
| 1937 | 23,921 | 4,712 | ([3]) | [2] 28,633 | [2] 431,212 |
| 1938 | 16,505 | 6,484 | [2] 187 | [2] 23,176 | [2] 416,401 |

[1] Small quantity of blue fiber from Transvaal included under Cape Province.
[2] Value of local sales plus value of exports.
[3] Small production in Natal in December 1936 and in 1937 included in 1938 figures.

The following table shows the tonnage of each variety produced from 1934 to 1938. A noteworthy feature is the striking decrease in chrysotile from Transvaal. This probably represents the effect of the reported early depletion of the Amianthus mine.

*Asbestos produced in the Union of South Africa, 1934–38, by varieties and sources, in short tons*

| Variety and source | 1934 | 1935 [1] | 1936 [1] | 1937 [2] | 1938 [2] |
|---|---|---|---|---|---|
| Amosite (Transvaal) | 3,757 | 4,684 | 4,823 | 6,531 | 8,793 |
| Chrysotile (Transvaal) | 11,025 | 15,483 | 16,149 | 16,855 | [3] 5,573 |
| Blue (Transvaal) | 1 | 2,541 | 216 | 535 | 2,326 |
| Blue (Cape) | 2,810 | | 4,048 | 4,712 | 6,484 |
| | 17,593 | 22,708 | 25,236 | 28,633 | 23,176 |

[1] Data from Government Mining Engineer, Union of South Africa, Department of Mines, Annual Report.
[2] Data from Union of South Africa, Department of Mines, Monthly Reports.
[3] Includes Natal.

*Swaziland.*—In January 1939 it was reported that development of the Havelock mine was proceeding satisfactorily and that production during 1939 was expected.

## CYPRUS

Tunnel Asbestos Cement (Ltd.) opened three new quarries during 1938. The following table, compiled mainly from the Annual Report of the Inspector of Mines and Labor, shows exports during recent years. Short-fiber chrysotile is produced.

*Asbestos exported from Cyprus, 1934–38*

| Year | Long tons | Value | Year | Long tons | Value |
|---|---|---|---|---|---|
| 1934 | 7,590 | [1] £73,562 | 1937 | 11,704 | £126,371 |
| 1935 | 7,513 | 50,174 | 1938 | 5,578 | 88,290 |
| 1936 | 9,506 | 80,343 | | | |

[1] Reported by Cyprus & General Asbestos Co. (Ltd.).

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## U. S. S. R.

The following table shows the most recent available statistics concerning Russian fibers:

*Production and exports of Russian asbestos, 1933–37, in metric tons*

| Year | Production | Exports | Year | Production | Exports |
|---|---|---|---|---|---|
| 1933 | 71,700 | [1] 21,458 | 1936 | 125,117 | [1] 26,147 |
| 1934 | 92,200 | [1] 33,715 | 1937 | (2) | [3] 27,299 |
| 1935 | 95,500 | [1] 25,109 | | | |

[1] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes.
[2] Data not available.
[3] Statistics of the Foreign Trade of the U. S. S. R.

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# BARITE AND BARIUM PRODUCTS [1]

By BERTRAND L. JOHNSON and K. G. WARNER

## SUMMARY OUTLINE


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The demand for crude barite in 1938 was less than in 1937. Declines of 7 percent in production and 13 percent in sales were accompanied by a further rise in the average value of crude barite sold or used by producers (to $6.47). The increased demand for barite for use in well drilling failed to counterbalance the lessened demand for other barium products resulting from the general industrial depression. Imports of crude barite were less than half those of 1937, while the average declared value of the imported barite rose over a dollar a ton. Total sales of barium products were only slightly less in 1938 than in 1937, but the value was more than 2 million dollars lower owing largely to the slump in sales of lithopone and blanc fixe. The quantity of ground barite sold or used by producers increased markedly because of the demand from the petroleum industry, but sales of other barium chemicals, except the dioxide and hydroxide, decreased.

*Salient statistics of the barite and barium products industries in the United States, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Crude barite: | | | | | |
| Produced—short tons | 178,361 | 218,075 | 274,062 | 360,877 | 335,433 |
| Sold or used by producers: | | | | | |
| Short tons | 209,850 | 225,111 | 283,160 | 355,888 | 309,663 |
| Value: [1] | | | | | |
| Total | $1,109,378 | $1,251,268 | $1,674,631 | [2] $2,240,970 | $2,004,521 |
| Average | $5.29 | $5.56 | $5.91 | [2] $6.30 | $6.47 |
| Imports for consumption: | | | | | |
| Short tons | 40,031 | 47,048 | 33,843 | 64,992 | 24,845 |
| Value: [3] | | | | | |
| Total | $174,937 | $246,254 | $170,316 | $327,224 | $151,235 |
| Average | $4.37 | $5.23 | $5.03 | $5.03 | $6.09 |
| Apparent new supply [4]—short tons | 249,881 | 272,159 | 317,003 | 420,880 | 334,508 |
| Domestic—percent | 84.0 | 82.7 | 89.3 | 84.6 | 92.6 |
| Reported consumption (total) short tons | 250,476 | 290,344 | 303,449 | 383,982 | [5] 364,985 |
| Barium products: | | | | | |
| Sold or used by producers: [6] | | | | | |
| Short tons | 228,796 | 268,652 | 263,810 | 332,185 | 327,102 |
| Value | $15,173,923 | $16,858,413 | $16,299,448 | $17,242,511 | $14,871,835 |
| Imports for consumption: | | | | | |
| Short tons | 9,459 | 11,672 | 11,079 | 14,419 | 8,334 |
| Value | $375,262 | $404,601 | $411,797 | $485,520 | $313,902 |
| Exports of lithopone: | | | | | |
| Short tons | 2,401 | 2,372 | 2,538 | 2,671 | 1,734 |
| Value | $199,508 | $221,611 | $229,942 | $231,622 | $153,567 |

[1] F. o. b. mine shipping point.
[2] Revised figures.
[3] Declared value f. o. b. foreign market.
[4] Barite sold or used by producers plus imports.
[5] Includes 7,121 short tons of crushed barite used in the glass industry.
[6] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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## CRUDE BARITE

*Production.*—Barite-mining operations were in progress in 1938 in nine States—Arizona, California, Georgia, Missouri, Nevada, South Carolina, Tennessee, Texas, and Virginia. Arizona and South Carolina produced barite in 1938 but not in 1937. Mine production in 1938 totaled 335,433 short tons, a decrease of 7 percent from 1937 (360,877 tons).

*Sales.*—After increasing nearly 73,000 tons from 1936 to 1937, the quantity of crude barite sold or used by producers fell in 1938 more than 46,000 tons from the 1937 levels (see fig. 1), and the value decreased $236,449. The average value per ton of domestic sales rose from $6.30 (revised figure) to $6.47 in 1938 (see fig. 2), continuing the rise from the low 1933 level and bringing it up nearly to the 1930 level.

Missouri, as usual, was the leading State in sales of barite, with Georgia second, but both reported decreases in 1938 from 1937.

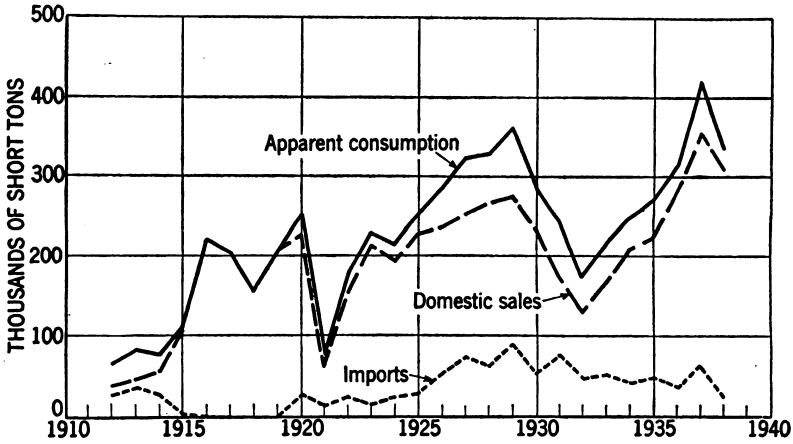


FIGURE 1.—Trends in domestic sales, imports, and apparent consumption of crude barite, 1912–38.

Sales were made by the same States in 1938 as in 1937, with the addition of Arizona and South Carolina and the elimination of Virginia. All the barite mined in Virginia in 1938 went into stocks.

*Crude barite sold or used by producers in the United States, 1937–38, by States*

| State | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Georgia | 71,944 | [1] $400,687 | 64,304 | $315,329 |
| Missouri | 198,101 | 1,430,397 | 156,539 | 1,150,630 |
| Other States [2] | 85,843 | 409,886 | 88,820 | 538,562 |
| | 355,888 | [1] 2,240,970 | 309,663 | 2,004,521 |

[1] Revised figures.
[2] 1937: California, Nevada, Tennessee, Texas, and Virginia; 1938: Arizona, California, Nevada, South Carolina, Tennessee, and Texas.

*Prices.*—The market quotation for crude barite from Georgia, f. o. b. mines, according to the Engineering and Mining Journal Metal and Mineral Markets, has remained unchanged at $7 per short ton

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from 1935 to 1938, inclusive. Missouri crude (93 percent barium sulfate, less than 1 percent iron) was quoted at $7.50 per short ton and crude barite (minimum 90 percent $BaSO_4$) at $6 to $6.50 f. o. b. mines in 1938. The average value, f. o. b. mine shipping point, of crude barite for the entire United States, as calculated from reports by producers to the Bureau of Mines, increased from $6.30 (revised figure) in 1937 to $6.47 in 1938.

*Consumption by uses.*—The consumption of crude barite (domestic and imported) in 1938 by manufacturers of barium products in the

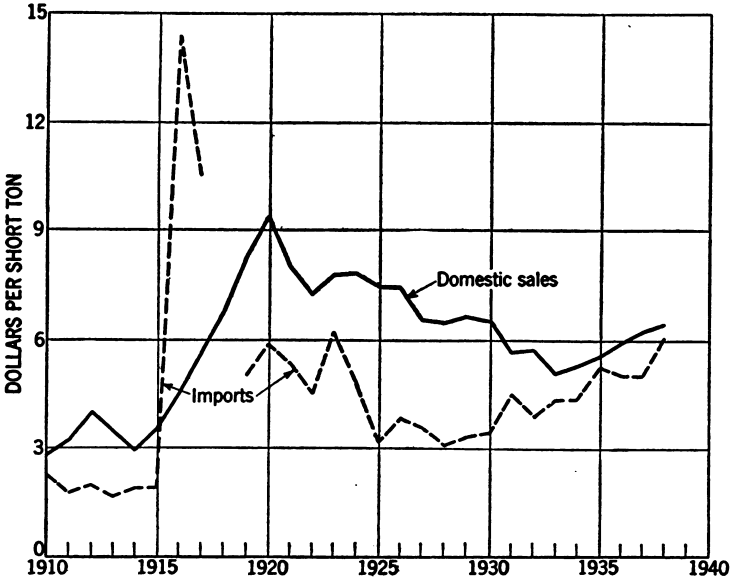


FIGURE 2.—Average value of domestic crude barite sold or used by producers and crude barite imported, 1910–38.

United States was about 19,000 tons less than in 1937, owing to large declines in the quantities of barite used in the manufacture of lithopone and barium chemicals that more than counterbalanced the large increase in the demand for ground barite. The upward trend in the quantity of crude barite used in the production of ground barite continued in 1938, with an increase of nearly 38,000 tons to a record total of 186,607 short tons. For the first time since 1916 more crude barite was used in the production of ground barite than in the production of lithopone. The quantity of crude barite consumed in lithopone production was less in 1938 than in any year since 1922.

*Crude barite (domestic and imported) used in the manufacture of barium products in the United States, 1934–38, in short tons*

| Year | In manufacture of— | | | Total | Year | In manufacture of— | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Ground barite | Lithopone | Barium chemicals | | | Ground barite | Lithopone | Barium chemicals | |
| 1934 | 61,123 | 140,734 | 48,619 | 250,476 | 1937 | 148,930 | 162,681 | 72,371 | 383,982 |
| 1935 | 93,692 | 146,164 | 50,488 | 290,344 | 1938 | 186,607 | 117,007 | 54,250 | [1] 364,985 |
| 1936 | 83,990 | 167,014 | 52,445 | 303,449 | | | | | |

[1] Includes 7,121 short tons of crushed barite used in the glass industry.

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*Consumption by States.*—Thirty-four plants in 13 States processed crude barite in 1938 compared with 31 plants in 12 States in 1937, producing ground barite, lithopone, and barium chemicals. The additional operations were in California (2), Missouri (1), and Rhode Island (1). One less plant operated in New York in 1938 than in 1937. These markets for crude barite lie in three general areas—the eastern or Atlantic Coast region, the midwestern or Mississippi Valley region, and the western or Pacific Coast region. The eastern and midwestern markets are by far the most important, each consuming 100,000 to 200,000 tons annually, whereas the western market consumes less than 60,000 tons. In 1938 a greater tonnage of crude barite was processed in the midwestern area than in the eastern, the Pacific Coast area still ranking third. Imports are confined largely to the Atlantic seaboard.

*Crude barite (domestic and imported) used in the manufacture of barium products in the United States in 1938, by States*

| State | Product manufactured | Plants | Barite used (short tons) |
|---|---|---|---|
| Missouri | Ground barite and chemicals | 5 | 122,921 |
| Delaware, New Jersey, and Pennsylvania | Lithopone and chemicals | 5 | 70,123 |
| California | Ground barite, lithopone, and chemicals | 8 | 57,930 |
| Illinois | do | 6 | 39,177 |
| Rhode Island | Chemicals | 1 | 67,713 |
| West Virginia | do | 2 | |
| Kansas | Lithopone | 1 | |
| Maryland | do | 1 | |
| Georgia | Ground barite and chemicals | 2 | |
| New York | do | 2 | |
| South Carolina | Ground barite | 1 | |
| | | [1] 34 | [2] 364,985 |

[1] A plant producing more than 1 product is counted but once in arriving at State totals.
[2] Includes 7,121 short tons of crushed barite used in the glass industry.

*Deposits.*—Several articles describing the barite deposits of Georgia, Tennessee, Virginia, and California were published in 1938.

The Cartersville barite district of Georgia was described by Kesler [2] and Hale.[3] Cartersville, the commercial center of the district, is on the western margin of a northeasterly trending mineralized belt 18 miles long by 2 miles wide. Crystalline barite of hydrothermal origin occurs in the highly fractured metamorphosed Shady dolomitic limestone of Lower Cambrian age. It fills fissures and forms irregular bodies, probably by replacement of the limestone. The Lower Cambrian rocks were folded and converted to low-grade metamorphic rocks during Appalachian mountain building near the end of Paleozoic time. Subsequently pegmatites were intruded, and hydrothermal solutions formed the mineral deposits of the district. Weathering of the dolomite by meteoric agencies followed the removal of the overlying rocks after Paleozoic times, and the commercial deposits of barite, rather definitely localized, occur in the residuum.

[2] Kesler, T. L., Sienna ("Ocher") Deposits of the Cartersville District, Ga.: Econ. Geol., vol. 34, No. 3, May 1939, pp. 324-341.
[3] Hale, D. P., Jr., Modern Mining and Beneficiation of Barite at Cartersville, Ga.: Am. Inst. Min. and Met. Eng. Tech. Pub. 973, 1938, 13 pp.

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The barite deposits of Tennessee were discussed in several articles [4] in 1938. Tennessee has two important barite-producing areas—the Sweetwater district in eastern Tennessee and the Pall Mall district in central Tennessee. In the Sweetwater district the commercial barite deposits occur as lumps and masses of barite in the residual clays overlying the Knox (Cambro-Ordovician) dolomite, the barite being derived from the weathering of barite-bearing veins in the dolomite. In the Pall Mall district the commercial ores occur in the residual clays derived from the underlying upper Mississippian limestone.

Edmundson [5] described in detail the numerous barite deposits of Virginia. The barite occurs in fissure veins, replacement masses, breccia zones, and residual deposits. The wall rocks of the deposits include pre-Cambrian marble, schist, and gneiss; Paleozoic limestone and dolomite; and Triassic shale, sandstone, and diabase. Many of the deposits extend to a depth of 150 feet. The barite is believed by Edmundson to have been formed by rising solutions of magmatic origin. It is not thought that all the barite deposits were formed at the same time, but it is believed that the mineralization took place after the Appalachian revolution and may be related to Triassic igneous activity.

The occurrence of barite in California was described by Pabst.[6]

*Technology.*—The technologic treatment of various eastern and midwestern barite ores is discussed in recent reports.[7]

*Foreign trade.*—A considerable tonnage of crude barite is imported annually into Atlantic coast ports. The general trend of these imports since 1929 has been downward (see fig. 1), accompanied by a rise in average value that in 1938 reached $6.09 per ton (see fig. 2). All imports in 1938 (only 38 percent of those in 1937) were of German and Cuban barite, and although nearly five times as much barite entered from Cuba in 1938 as in 1937 the great decrease in imports from Germany lowered the total sharply. In 1938, 74 percent of the imports originated in Germany (partly transshipped from the Netherlands) and the rest in Cuba. Total imports of crude barite were the smallest since 1924.

Barite deposits in the Province of Pinar del Rio, Cuba, were worked during 1937 to supply demand in the United States, which did not, however, become as important as was anticipated. Exploitation of these deposits stimulated interest in other deposits of barite, but owing to lack of demand no additional production is known to have resulted.[8] No data are available regarding developments in 1938.

[4] Whitlatch, G. I., Barite: Tennessee Dept. of Conservation, Div. Geol., Markets Circ. 7, 2d ed., Nashville, Tenn., 1938, 25 pp.
Penhallegon, W. J., Barite in the Tennessee Valley Region: Tennessee Valley Authority, Water Control Planning Dept., Geol. Div., Knoxville, Tenn., June 1938, 47 pp.
Laurence, R. A., Origin of the Sweetwater (Tenn.), Barite Deposits: Econ. Geol., vol. 34, No. 2, March-April 1939, pp. 190-200; Black Barite Deposits in Upper East Tennessee: Jour. Tennessee Acad. Sci., vol. 13, No. 3, July 1938, pp. 192-197.
Rankin, H. S., Laurence, R. A., Davis, F. A. W., Houston, E. C., and McMurray, L. L., Concentration Tests on Tennessee Valley Barite: Am. Inst. Min. and Met. Eng. Tech. Pub. 880, Min. Technol., March 1938. 13 pp.

[5] Edmundson, R. S., Barite Deposits of Virginia: Virginia Geol. Survey Bull. 53, 1938, 85 pp.

[6] Pabst, Adolf, Minerals of California: California Dept. Natural Resources, Div. Mines Bull. 113, 1938, 344 pp. (See pp. 172-175.)

[7] Hale, D. P., Jr., work cited in footnote 3.
Whitlatch, G. I., work cited in footnote 4.
Penhallegon, W. J., work cited in footnote 4.
Rankin, H. S., and others, work cited in footnote 4.
Edmundson, R. S., work cited in footnote 5.
Lieberman, H. R., Les Miserables in Missouri: Ken, Mar. 9, 1939. pp. 26-27, 47-49.
O'Meara, G., and Coe, G. D., Concentration of Southern Barite Ores: Bureau of Mines Rept. of Investigations 3376, 1938, 12 pp.

[8] Tewell, H. S., American consul, Habana, Cuba, Cuban Mineral Production in 1937: Consular Rept. Mar. 16, 1938, 8 pp.

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*Crude barite imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Cuba | 1,345 | $6,298 | 6,367 | $27,578 |
| Germany | 16,099 | 62,605 | 4,200 | 27,188 |
| Greece | 9,026 | 52,057 | | |
| Italy | 204 | 1,832 | | |
| Netherlands | 38,301 | 204,298 | 14,278 | 96,469 |
| Yugoslavia | 17 | 134 | | |
| | 64,992 | 327,224 | 24,845 | 151,235 |

Exports of crude barite from the United States are not separately recorded.

*World production.*—Barite is produced in many countries. Germany and the United States are by far the outstanding producers. In 1937 the United Kingdom, Italy, Greece, and France ranked next in order of output.

*World production of barite, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Algeria | | | | 2,137 | (1) |
| Australia: | | | | | |
| New South Wales | 187 | 207 | 149 | 268 | (1) |
| South Australia | 2,345 | 2,378 | 2,009 | 2,736 | 2,909 |
| Tasmania | | | 34 | 77 | (1) |
| Victoria | | | | 71 | (1) |
| Brazil (exports) | | | | 600 | (1) |
| China | 9,500 | (1) | (1) | (1) | (1) |
| Chosen | 5,935 | 11,027 | 5,113 | 8,400 | (1) |
| Cuba | | | | 3,849 | |
| Czechoslovakia | 2,094 | (1) | (1) | (1) | (1) |
| Egypt | 50 | 85 | 30 | 51 | (1) |
| France | 18,350 | 16,900 | 22,200 | 19,850 | (1) |
| Germany: | | | | | |
| Austria | 1,025 | 797 | 1,663 | 855 | (1) |
| Baden | 19,681 | 12,445 | 17,800 | 21,653 | (1) |
| Bavaria | 8,385 | 7,073 | 11,175 | 11,832 | (1) |
| Prussia [2] | 326,318 | 326,950 | 392,103 | 410,634 | (1) |
| Saxony | 484 | 222 | 467 | 432 | (1) |
| Thuringia | (1) | 554 | 450 | 6,790 | (1) |
| Württemburg | (1) | (1) | 1,000 | 192 | (1) |
| Greece | 7,853 | 23,091 | 31,336 | 39,343 | (1) |
| India, British | 3,874 | 5,581 | 5,196 | 15,941 | (1) |
| Indochina | | | 40 | 45 | (1) |
| Italy | 32,408 | 41,152 | 36,671 | 45,202 | (1) |
| Japan | | | 3,837 | (1) | (1) |
| Norway | | | 408 | 70 | (1) |
| Portugal | 1 | | 10 | 101 | 24 |
| Southern Rhodesia | 14 | | | | 91 |
| Spain | 17,528 | (1) | (1) | (1) | (1) |
| Union of South Africa | 1,732 | 627 | 583 | 570 | 410 |
| U. S. S. R. | 74,800 | (1) | (1) | (1) | (1) |
| United Kingdom | 75,182 | 79,386 | 74,242 | 74,485 | 77,525 |
| United States | 161,806 | 197,833 | 248,624 | 327,380 | 304,298 |

[1] Data not available.
[2] Official figures which, it is reported, cover only output of mines included under the mining law.

Germany [9] is the leading world producer of barite, furnishing about one-half of the total world output. The principal barite deposits are at Bad Lauterberg on the southern rim of the Harz Mountains massif. One-half the German barite production comes

[9] Redecker, S. B., American consul, Frankfurt-am-Main, Germany, German Production of Barium Materials: Consular Rept., Mar. 21, 1930, 8 pp.

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from this region. Another leading center of production is Nordhausen in the Harz Mountains. Germany's consumption of barite has expanded markedly in recent years as a result of heavily increased demand for barite and its derivatives in the manufacture of pigments, paints, ceramics, waterproofing and softening agents, explosives, paper, rubber goods, and other commodities. Domestic consumption of barite in pigments has increased in recent years because of official requirements for mixing the cheaper and abundantly available barium sulfate with red lead, of which there has been a shortage in Germany, and thus extending the supplies of red lead.

In international barite trade Germany holds an even more important position than in barite production, as over half of the large German production is exported. Germany likewise has an extensive foreign trade in barium chemicals, especially lithopone, blanc fixe, artificial barium carbonate, barium chloride, and barium nitrate. Germany's export trade in barite and barium materials recorded favorable development from 1935 to 1937, but a considerable recession occurred in 1938.

## BARIUM PRODUCTS

*Sales.*—Because of the increased demand from the petroleum well-drilling industry, sales of ground barite were much greater in 1938 than in 1937. Sales of lithopone, blanc fixe, and artificial barium carbonate followed the general industrial decline and decreased in 1938; however, sales of other barium chemicals increased. Detailed statistics of sales of barium products during the past 5 years are given in the following table.

*Barium products sold or used by producers in the United States, 1934–38* [1]

| Product | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Ground barite: | | | | | |
| Plants | 13 | 11 | 13 | 12 | 14 |
| Short tons | 53,326 | 76,250 | 69,102 | 129,777 | [2] 161,422 |
| Value | $1,006,905 | $1,407,787 | $1,217,818 | $2,249,612 | [2] $2,786,823 |
| Lithopone: | | | | | |
| Plants | 11 | 11 | 11 | 11 | 11 |
| Short tons | 145,565 | 159,486 | 158,319 | 154,771 | 125,746 |
| Value | $12,235,624 | $13,470,274 | $12,976,754 | $12,069,790 | $9,975,012 |
| Blanc fixe (precipitated barium sulfate): | | | | | |
| Plants | 6 | 6 | 6 | 7 | 7 |
| Short tons | 18,115 | 18,067 | 16,149 | 28,250 | 19,428 |
| Value | $1,084,733 | $980,191 | $890,310 | $1,614,764 | $921,203 |
| Artificial barium carbonate (chemically precipitated): | | | | | |
| Plants | 4 | 3 | 3 | 3 | 4 |
| Short tons | 4,706 | 7,329 | 11,347 | 10,755 | 9,543 |
| Value | $245,315 | $357,585 | $515,624 | $511,357 | $459,901 |
| Other barium chemicals: [3] | | | | | |
| Plants | 7 | 5 | 7 | 6 | 5 |
| Short tons | 7,084 | 7,520 | 8,893 | 8,632 | 10,963 |
| Value | $601,346 | $642,576 | $698,942 | $796,988 | $728,896 |
| Total barium products: | | | | | |
| Short tons | 228,796 | 268,652 | 263,810 | 332,185 | 327,102 |
| Value | $15,173,923 | $16,858,413 | $16,299,448 | $17,242,511 | $14,871,835 |

[1] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.

[2] Includes crushed barite used in the glass industry.

[3] Figures cover chemicals, in order of value, as follows—1934–35 and 1937: Chloride, dioxide, sulfide, and hydroxide; 1936 and 1938: Chloride, dioxide, sulfide, hydroxide, and oxide.

Lithopone is the most important single chemical made from barium sulfide. The combination of solutions of barium sulfide and zinc sulfate yields lithopone as a white intimate mixture or coprecipitate of

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zinc sulfide and barium sulfate. Lithopone is used principally in the paint industry. (See fig. 3.) Sales for this purpose constituted over 81 percent of the total sales in 1938. Smaller quantities are consumed

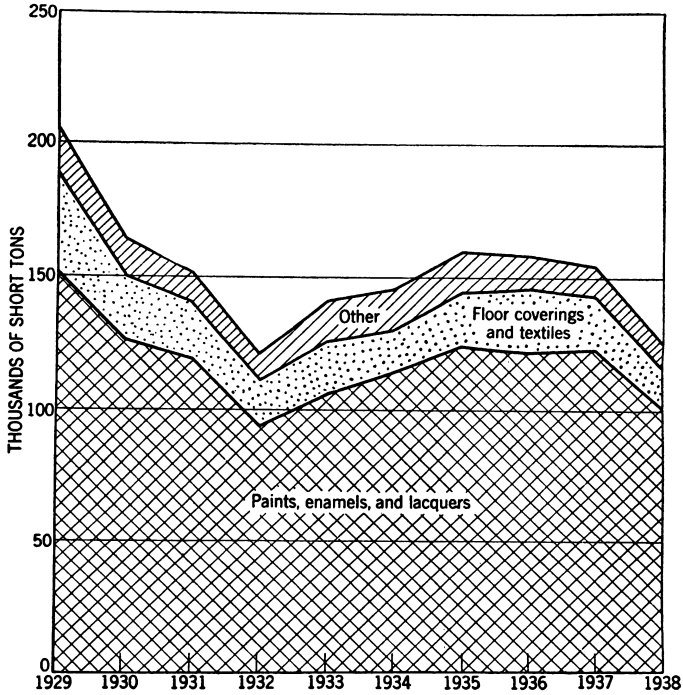


FIGURE 3.—Lithopone sold or used by producers, 1929–38, by consuming industries.

by the floor covering, textiles, and rubber industries. Sales of lithopone for all major uses decreased in 1938.

*Lithopone sold or used by producers, 1936–38, by consuming industries*

| Industry | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Percent of total | Short tons | Percent of total | Short tons | Percent of total |
| Paints, enamels, and lacquers | 122,461 | 77.3 | 122,915 | 79.4 | 101,924 | 81.1 |
| Floor coverings and textiles | 23,085 | 14.6 | 20,194 | 13.1 | 15,400 | 12.2 |
| Rubber | 4,908 | 3.1 | 4,383 | 2.8 | 3,148 | 2.5 |
| Other | 7,865 | 5.0 | 7,279 | 4.7 | 5,274 | 4.2 |
| | 158,319 | 100.0 | 154,771 | 100.0 | 125,746 | 100.0 |

*Prices.*—Quotations for ground barite were the same in 1938 as in 1937. For ground witherite, however, prices were down somewhat from 1937, although those for precipitated barium carbonate were unchanged. Lithopone quotations showed slightly lower limits, in most instances one-eighth cent less. Lower prices also were quoted for barium nitrate. Prices for barium chloride had a smaller range, the lowest price quoted during 1938 being $77 compared with $74 in 1937. Details are given in the accompanying table, quotations being taken entirely from Chemical Industries.

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*Range of quotations on barium products, 1936–38* [1]

| | 1936 | 1937 | 1938 |
|---|---|---|---|
| Ground barite, carlots, 350-pound barrels, works, short ton | $23.65 –$31.15 | $23.65 | $23.65 |
| Ground witherite, carlots, bags, works [2] ---do | 42.00 – 45.00 | $42.00 – 45.00 | $41.00 – 44.00 |
| Lithopone: | | | |
| Domestic, ordinary, delivered, bags ---pound | .04¼– .04¾ | .04¼– .04⅝ | .04⅛– .04⅝ |
| Do ---barrels ---do | .04½– .05 | .04½– .04⅞ | .04⅝– .04⅞ |
| High strength, bags ---do | .05¾– .06¼ | .05¾– .06⅛ | .05⅝– .06⅛ |
| Do ---barrels ---do | .06 – .06½ | .06 – .06⅜ | .05⅞– .06⅜ |
| Titanated, bags ---do | .05¾– .06¼ | .05¾– .06⅛ | .05⅝– .06⅛ |
| Do ---barrels ---do | .06 – .06½ | .06 – .06⅜ | .05⅞– .06⅜ |
| Barium carbonate, precipitated, 200-pound bags, works, short ton | 56.50 – 61.00 | 52.50 – 62.50 | 52.50 – 62.50 |
| Barium chlorate, 112-pound kegs, New York, pound | .15½– .17½ | .16½– .17½ | .16½– .17½ |
| Barium chloride, barrels, delivered zone 1, short ton | 72.00 – 74.00 | 74.00 – 92.00 | 77.00 – 92.00 |
| Barium dioxide (binoxide or peroxide), 88 percent, 690-pound drums ---pound | .11 – .12 | .11 – .12 | .11 – .12 |
| Barium hydrate, 500-pound barrels ---do | .05¼– .06 | .04¾– .05½ | .04¾– .05½ |
| Barium nitrate, barrels ---do | .07 – .08¼ | .07 – .08¼ | .06¾– .08¼ |
| Barium sulfate, precipitated (blanc fixe), 400-pound barrels, works, short ton | [3] 42.50 – 70.00 | [3] 40.00 – 75.00 | [3] 40.00 – 75.00 |

[1] Chemical Industries (formerly Chemical Markets), New York (monthly).
[2] 90 percent.
[3] Lowest price for pulp grade, highest for high-grade precipitated.

*Preparation and uses.*—Crude barite ($BaSO_4$) is the raw material used in the preparation of most barium products. The treatment accorded to the barite in the manufacture of these various barium compounds is either (1) physical—grinding and refining for the production of crushed or ground barite —or (2) chemical—the furnace reduction of the barite with carbon, leaching of the "black ash" produced, and recovery of barium sulfide solution, which is used as the base for the preparation of various other barium chemicals, such as the sulfate, carbonate, chloride, and oxide.

Ground barite is used principally as a heavy medium in mud in the drilling of deep oil wells where high gas pressures are encountered. This use took nearly 80 percent of the total sales of ground barite in 1938. No other use takes over 5 percent of the total sales. The accompanying table shows the quantity and percentages of ground or refined barite sold or used by producers in 1938 by consuming industries; these data are available this year for the first time. Another important barium chemical is precipitated barium sulfate, known commercially as "blanc fixe." It is a very fine grained white powder, ordinarily prepared from a solution of barium sulfide by the addition of sodium sulfate (salt cake) but also obtained as a byproduct in the manufacture of hydrogen peroxide by the use of barium peroxide. Witherite, natural barium carbonate, is sometimes the raw material for its preparation. Blanc fixe is used as a filler, as a pigment in paints, in cosmetics, in paper manufacture, and for barium meals in X-ray photography.

*Ground or refined barite sold or used by producers in 1938, by consuming industries*

| Industry | Short tons | Percent of total | Industry | Short tons | Percent of total |
|---|---|---|---|---|---|
| Well drilling | 126,697 | 79 | Other [1] | 13,576 | 8 |
| Paint | 8,227 | 5 | Not reported | 2,015 | 1 |
| Glass | [2] 7,963 | 5 | | | |
| Rubber | 2,944 | 2 | | [2] 161,422 | 100 |

[1] Includes barite used in making paper, oilcloth, linoleum, cloth, and sugar, as well as minor quantities used in other industries.
[2] Includes some crushed barite used in the glass industry.

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The following list includes producers of blanc fixe reporting production to the Bureau of Mines in 1938:

Barium Products Co. Ltd., Modesto, Calif.
Barium Reduction Corporation, South Charleston, W. Va.
E. I. du Pont de Nemours & Co., Room 10032, du Pont Building, Wilmington, Del.
Hercules Powder Co., Providence Drysalters Division, Wilmington, Del.
National Lead Co., Titanium Division, 111 Broadway, New York, N. Y.
Oakland Chemical Co., 59 Fourth Avenue, New York, N. Y.
Standard Ultramarine Co., Huntington, W. Va.

*Foreign trade.*—Imports of all classes of barium compounds for consumption in the United States in 1938 decreased both in quantity and value from 1937, except "barium compounds not elsewhere specified." Less than half the quantity of witherite was imported in 1938 as in 1937.

*Barium compounds imported for consumption in the United States, 1934–38*

[Value at port of shipment]

| Year | Ground barite | | Lithopone | | Barium dioxide | | Blanc fixe (precipitated barium sulfate) | | Barium carbonate (precipitated) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Pounds | Value | Short tons | Value | Short tons | Value |
| 1934 | 1,863 | $16,916 | 3,927 | $219,752 | 370 | $58 | 459 | $26,156 | ------- | ------- |
| 1935 | 3,354 | 28,766 | 4,603 | 256,731 | 450 | 72 | 141 | 9,403 | 11 | $631 |
| 1936 | 2,873 | 28,397 | 4,781 | 273,571 | 1,392 | 223 | 123 | 6,971 | 30 | 889 |
| 1937 | 3,313 | 35,046 | 5,601 | 302,417 | 229 | 34 | 109 | 7,617 | 30 | 848 |
| 1938 | 1,700 | 15,466 | 3,932 | 207,115 | 100 | 13 | 106 | 5,102 | (1) | 32 |

| Year | Witherite, crude, unground | | Barium chloride | | Barium nitrate | | Barium hydroxide | | Barium oxide | | Barium compounds (n. e. s.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value | Pounds | Value | Short tons | Value |
| 1934 | 2,358 | $43,808 | 107 | $4,808 | 454 | $44,884 | 287 | $17,548 | 132 | $66 | 4 | $1,266 |
| 1935 | 2,634 | 48,551 | 392 | 17,170 | 258 | 24,412 | 271 | 16,987 | 33 | 26 | 8 | 1,852 |
| 1936 | 2,464 | 44,475 | 244 | 10,355 | 185 | 19,107 | 370 | 25,423 | 287 | 155 | 8 | 2,231 |
| 1937 | 4,556 | 82,341 | 315 | 13,761 | 157 | 15,836 | 310 | 21,004 | 298 | 161 | 28 | 6,455 |
| 1938 | 2,115 | 43,568 | 69 | 2,351 | 126 | 12,061 | 236 | 16,874 | ------- | ------- | 50 | 11,320 |

[1] 110 pounds.

Both the quantity and value of exports of lithopone in 1938 were less than in any year since 1933.

*Lithopone exported from the United States, 1934–38*

| Year | Short tons | Value | | Year | Short tons | Value | |
|---|---|---|---|---|---|---|---|
| | | Total | Average | | | Total | Average |
| 1934 | 2,401 | $199,508 | $83.09 | 1937 | 2,671 | $231,622 | $86.72 |
| 1935 | 2,372 | 221,611 | 93.43 | 1938 | 1,734 | 153,567 | 88.56 |
| 1936 | 2,538 | 229,942 | 90.60 | | | | |

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# POTASH

By J. H. Hedges

SUMMARY OUTLINE


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Producers in the United States made and sold more potash salts in 1938 than ever before, although both domestic consumption and exports receded from the 1937 peak. Imports dropped 45 percent to 193,609 tons $K_2O$ in 1938 from 351,445 tons $K_2O$ in 1937, but importers appear to have withdrawn about 96,000 tons of salts equivalent to around 40,000 tons of $K_2O$ from stocks accumulated in 1937. Domestic producers supplied about 52 percent of the 467,000 tons of potash ($K_2O$) that moved from primary sources into domestic channels for consumption.

Domestic output rose 11 percent in 1938 to 534,945 short tons of salts equivalent to 316,951 tons of $K_2O$ from 486,090 tons equivalent to 284,497 tons of $K_2O$ in 1937. The average grade was 59.2 percent $K_2O$ in 1938 compared with 58.5 percent in 1937. Production exceeded sales by more than 30,000 tons of potash, and producers' stocks were correspondingly increased, the year-end carry-over rising to 87,000 tons of $K_2O$.

Producers sales expanded 7 percent to 286,437 tons of potash in 1938 from 266,938 in 1937, notwithstanding a drop of around 10,000 tons in domestic consumption, and the value at the plant increased to $9,748,290 compared with $9,019,534 in 1937. The 1938 average value of $19.57 per ton was 25 cents more than the 1937 average.

Estimates of consumption based on sales reported for 1938 are not directly comparable with the corresponding figures for 1937 because final delivery dates on orders placed with the principal producers and importers during the discount periods were advanced in 1938 to December 31, whereas 1937 contracts called for delivery in approximately equal monthly installments to January 31, 1938. Hence, 1938 sales and consumption figures might be considered to represent 13 months' business if calculated on the same basis as those for 1937. If the custom of previous years had been followed 20,000 to 30,000 tons of potash might have been delivered in January 1939 on 1938 contracts and would then have been reported as 1939 sales. Therefore, for the purpose of comparing the use of potash in agriculture and industry in 1938 with that in 1937, the 1938 consumption probably



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should be estimated at around 440,000 tons, although producers and importers actually delivered 467,000 tons to buyers for manufacture into fertilizer and other minor uses. The decline in fertilizer sales reported by the National Fertilizer Association—from 8,195,000 tons in 1937 to 7,504,000 tons in 1938—would indicate a shrinkage of 35,000 to 40,000 tons in the amount of potash consumed on American farms.

The effect of completing deliveries on 1938 contracts within the calendar year is evident also in the 40,000-ton drop in deliveries reported by the American Potash Institute for the first quarter of 1939 compared with the corresponding period of 1938.

Output of the American Potash & Chemical Corporation at Trona, Calif., and that of the United States Potash Co. and of the Potash Co. of America near Carlsbad, N. Mex., comprised over 98 percent of the total production. The California company extracts potash and other salts from the brine of Searles Lake, and at the two New Mexico operations sylvinite is mined from a depth of about 1,000 feet and refined at nearby plants. Small shipments of crude minerals from various operations in Utah and Wyoming contributed unimportant amounts to the total, and a few thousand tons of potash-bearing material was recovered from distillery waste and cement flue dust. Bonneville, Ltd., a Salt Lake corporation operating near Wendover, Utah, began in July small but steady shipments of muriate extracted from the brines of Salduro marsh, by methods recently developed.

Imports were mainly of German and French origin, although increased shipments were received from Palestine and Spain, and importation of crude saltpeter from Chile continued. It is doubtful whether the Spanish mines were worked at all during 1938, and shipments by the Loyalist Government probably came from stocks at Barcelona. Following the victory of the Nationalist forces under General Franco the return of the potash mines to their owners is anticipated, and production and export doubtless will be resumed under the old arrangement with the International Cartel.

The decrease in exports from approximately 62,000 tons of potash in 1937 to 51,800 tons in 1938 was explained by the decline in shipments to Japan that was only partly offset by larger sales to Belgium and Norway. About 16,000 tons of salts containing nearly 10,000 tons of potash represented resales by customers of producers and importers. The economic situation in Japan may result in further curtailment of sales to that country, which in 1938 maintained its position as America's best customer for potash in spite of reduced imports.

The Potash Export Association, Inc., organized by American Potash & Chemical Corporation, United States Potash Co., and Potash Co. of America, to handle their export sales, filed a statement in December with the Federal Trade Commission, under the Webb-Pomerene Export Trade Act of 1918, setting forth its place of business, officers, and members and declaring its purpose to engage in exporting potash salts. This act exempts from antitrust laws associations entered into for the sole purpose of engaging in export trade "provided such association, agreement, or act is not in restraint of trade within the United States, and is not in restraint of the export trade of any domestic competitor of such association."

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Salient statistics of the domestic potash industry for 1937 and 1938 are summarized in the following table:

*Salient statistics of the potash (crude and refined potash materials) industry in the United States, 1937–38*

| | 1937 | 1938 |
|---|---|---|
| Production: | | |
| Potassium salts, short tons | 486,090 | 534,945 |
| Approximate equivalent, $K_2O$, do | 284,497 | 316,951 |
| Sales: | | |
| Potassium salts, do | 466,933 | 498,189 |
| Approximate equivalent, $K_2O$, do | 266,938 | 286,437 |
| Value at plant | $9,019,534 | $9,748,290 |
| Average per ton | $19.32 | $19.57 |
| Imports: | | |
| Crude and refined, short tons | 810,529 | 450,387 |
| Approximate equivalent, $K_2O$, do | 351,445 | 193,609 |
| Value | $19,733,076 | $13,512,110 |
| Exports: | | |
| Fertilizer materials, short tons | 103,031 | 84,137 |
| Approximate equivalent, $K_2O$, do | 61,000 | 50,500 |
| Value | $3,278,895 | $2,599,772 |
| Other, short tons | 2,094 | 2,616 |
| Approximate equivalent, $K_2O$, do | 1,000 | 1,300 |
| Value | $484,450 | $485,672 |

## PRICES

Except for shortening to December 31 the delivery period on orders subject to the published discounts, schedules of prices issued by producers and importers in May 1938 were virtually identical with those of the year before. Muriate was quoted at 53½ cents per unit of $K_2O$, 30-percent manure salts at 58½ cents, 20-percent kainite at $12.75 per ton in bulk, sulfate of potash (90-percent $K_2SO_4$) at $38 per ton in bags, and sulfate of potash-magnesia (48-percent $K_2SO_4$) at $25.75 per ton in bags. As usual, prices were guaranteed against reduction. A 12-percent discount was offered on orders placed before July 1 for delivery in approximately equal monthly installments to December 31 and 5 percent on orders placed from July 1 to September 30 for delivery to December 31. On orders placed after September 30 for delivery during the remainder of the fertilizer year to May 31, 1939, prices were net.

The following table shows the monthly average prices prevailing during 1938 in accordance with published schedules:

*Average prices per short ton of potash salts in 1938, by months*

| Month | Muriate of potash, 50-percent $K_2O$, in bulk | Sulfate of potash, 90-percent $K_2SO_4$, in bags | Sulfate of potash-magnesia, 48-percent $K_2SO_4$, in bags | Manure salts, 30-percent $K_2O$, in bulk | Kainite, 20-percent $K_2O$, in bulk |
|---|---|---|---|---|---|
| January to May | $26.75 | $38.00 | $25.75 | $17.55 | $12.75 |
| June | 23.54 | 33.44 | 22.66 | 15.44 | 11.22 |
| July to September | 25.41 | 36.10 | 24.46 | 16.67 | 12.11 |
| October to December | 26.75 | 38.00 | 25.75 | 17.55 | 12.75 |

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## CONSUMPTION AND USES

Approximately 467,000 tons of potash were sold in 1938 by producers and importers for the manufacture of mixed fertilizers and for chemical and other industrial uses in the United States. About 94 percent of the total was destined for use in agriculture. From information available to the Bureau of Mines no estimate can be made of ultimate consumption by application to the soil or utilization in industry.

The American Potash Institute reports that deliveries by member companies in the United States and its possessions in 1938 totaled 439,561 tons of potash and that 40,843 tons were exported. Importations and sales of all other primary suppliers amounted to 38,938 tons, indicating a total movement of potash of 519,342 tons from primary sources to buyers. Deducting exports of 51,800 tons leaves 467,542 tons sold for consumption in the United States. Apparent consumption calculated by subtracting exports (51,800 tons) from the sum of domestic sales (286,437 tons) and imports (193,609) was only 428,246 tons. The difference of 39,296 tons appears to have been withdrawn from previously accumulated importers' stocks. The basis of this estimate is shown in the following tabulation of deliveries by member companies of the American Potash Institute, sales by nonmember producers, entries by nonmember importers, and total exports.

*Sales of primary potash for consumption and export in 1938, in short tons*

| | Bulk salts | Equivalent $K_2O$ |
|---|---|---|
| Deliveries by member companies, as reported by American Potash Institute: | | |
| In United States and possessions: | | |
| Agricultural | 821,406 | 423,977 |
| Chemical | 25,591 | 15,584 |
| For export | 68,116 | 40,843 |
| | 915,113 | 480,404 |
| Imports not included above plus sales of nonmember producers | 129,872 | 38,938 |
| | 1,044,985 | 519,342 |
| Total exports | 86,753 | 51,800 |
| Actual sales for consumption in United States | 958,232 | 467,542 |
| Apparent consumption | 861,823 | 428,246 |
| Apparent withdrawals from importers' stocks | 96,409 | 39,296 |

## PRODUCTION AND SALES

The tonnage of potash in marketable salts produced by mines and plants in the United States continued the upward trend begun in 1922 from the low level of postwar liquidation. The increase of 11 percent—from 284,497 tons in 1937 to 316,951 in 1938—was only slightly less than the 13-percent gain made in 1937. Sales, however, increased only 7 percent, and about 32,000 tons were added to stocks. Value at the plant of salts sold increased $728,756 (8 percent) to $9,748,290. The average grade of salts produced was 59.2 percent $K_2O$, an increase of 0.7 percent from the 1937 average. About 52 percent of the home market was supplied by producers, and about 8.5 percent of their sales were for export.

One new source of potential importance was exploited during the year by Bonneville, Ltd., which began in July small shipments of high-

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grade muriate recovered from brines of the Salduro marsh at Wendover, Utah. Nearly 900,000 tons of crude salts averaging about 25 percent $K_2O$ were mined from the bedded saline deposits in New Mexico.

Production and sales of marketable potassium salts and stocks in the hands of producers for the last 5 years are summarized in the following table. Only the final weight of marketable salts after refining or mixing is shown. For similar data from the beginning of the potash-producing industry in 1915 to 1934 see the chapter on Potash in the Minerals Yearbook 1935. Data by States and sources cannot be given without disclosing individual reports.

*Potassium salts produced, sold, and in producers' stocks in the United States, 1934–38*

| Year | Production | | | Sales | | | | Producers' stocks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Operators | Potassium salts (short tons) | Equivalent as potash ($K_2O$) (short tons) | Operators | Potassium salts (short tons) | Equivalent as potash ($K_2O$) (short tons) | Value f. o. b. plant | Operators | Potassium salts (short tons) | Equivalent as potash ($K_2O$) (short tons) |
| 1934 | 8 | 275,732 | 144,342 | 8 | 224,875 | 114,122 | $2,813,218 | 4 | 95,844 | 50,066 |
| 1935 | 10 | 357,974 | 192,793 | 10 | 406,922 | 224,721 | 4,993,481 | 6 | 47,710 | 18,060 |
| 1936 | 7 | 431,470 | 247,340 | 7 | 396,690 | 222,810 | 6,969,190 | 5 | 73,139 | 34,000 |
| 1937 | 7 | 486,090 | 284,497 | 7 | 466,933 | 266,938 | 9,019,534 | 5 | 105,900 | 55,620 |
| 1938 | 9 | 534,945 | 316,951 | 9 | 498,189 | 286,437 | 9,748,290 | 6 | 158,540 | 87,440 |

## GOVERNMENT ACTIVITIES

The Senate investigation of the potash industry, started in 1936 under authority of Senate Resolution 274, 74th Congress, 2d Session and pursued spasmodically during 1937, was virtually recessed during 1938 following a 2-year extension, authorized May 18, 1938, of the time allowed the committee for completing the investigation and reporting to the Senate. The inquiry is in charge of a subcommittee of the Senate Committee on Public Lands and Surveys. It was instituted to determine whether unfair or illegal practices were being employed in the exploitation of potash resources and the extent of foreign ownership or control of American potash companies. The fact that the investigation is languishing leads to the surmise that the industry was found to be functioning reasonably well in the public interest. The three important operations afford employment at high wages to about 1,800 men and have been developed, without benefit of tariff protection, in competition with low-cost foreign producers to a degree that insures independence of foreign supplies.

Potash Reserve No. 6, New Mexico No. 1, withdrawn from entry by Executive order of March 11, 1926, and Potash Reserve No. 7, New Mexico No. 2, withdrawn by Executive order of June 8, 1929, together comprise 9,282,160 acres and include all of Lea, Roosevelt, and Curry Counties and parts of Eddy, Chavez, and De Baca Counties in southeastern New Mexico. In these areas, insofar as title remains in the United States, potassium and sodium deposits are severed from the surface and reserved to the United States, subject to lease under the mineral leasing laws. All mining operations on public land mineral leases are supervised by the Geological Survey, which is likewise charged with land classification.

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Several leases were issued during the year by the Secretary of the Interior, including three to the Union Potash & Chemical Corporation, whose applications had been pending for some time.

## REVIEW BY STATES

*California.*—Operations of the American Potash & Chemical Corporation at Trona, Calif., continued throughout the year. In addition to potash, borax, soda ash, and salt cake this company is now recovering lithium from the complex brine of Searles Lake in the form of sodium lithium phosphate containing about 22 percent lithia, which is sold to a company that supplies the trade with lithium salts for various uses. The rapid growth of air-conditioning, in which lithium chloride is used for dehumidifying the air, is fast creating a broader market for lithium salts.

*Maryland.*—Byproduct potash was produced by the North American Cement Corporation at Hagerstown and the United States Industrial Chemical Co. at Baltimore, the former from cement-kiln dust and the latter from distillery waste. These two companies annually supply a few thousand tons of material that is marketed as agricultural potash.

*New Mexico.*—Output of the two potash mines near Carlsbad in 1938 approached 900,000 tons of crude salts averaging about 25 percent $K_2O$—the largest mine production yet recorded. The United States Potash Co. and the Potash Co. of America are the only producers in the State. Most of their mine product is refined and sold in the form of high-purity muriate, although there is still a relatively small market for run-of-mine and mixed salts of lower analysis. First shipments from this area were made in 1931, and development since that time has been rapid.

The shaft of the Union Potash & Chemical Corporation was completed by the International Agricultural Corporation to a depth of 925 feet, and levels were opened at 787 feet and 907 feet, under an option agreement understood to involve a controlling interest in the property. Additional drilling is now in progress to explore further the three leases, aggregating 7,680 acres, that constitute the present holdings. Numerous potash-bearing beds were cut by the shaft, the more important being mixtures of langbeinite and sylvite. In this respect the deposit appears to differ from others in the district now being mined, where langbeinite is not found in important quantities.

*Utah.*—The early potash investigations of the Geological Survey, beginning in 1911, included a study of the brines of the Salduro marsh in western Utah, which were found to contain varying amounts of potassium chloride associated with sodium and magnesium salts. Under the stimulus of high prices created by the potash shortage during the World War plants were built to recover potash from these brines, and several thousand tons of fairly high-grade muriate were produced. However, costs were high, and when imports were resumed and prices returned to normal after the war the plants were forced to close. No potash from this source was reported after 1921. In 1938 operations in this area were resumed on a small scale by Bonneville, Ltd., following extended experimentation. The plant of this company is near Wendover, close to the Nevada line. The first shipment was made in July, and shipments continued throughout the rest of the year. Crude salts are recovered from the brine by solar evaporation and refined to produce high-grade muriate.

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## FOREIGN TRADE [1]

*Imports.*—Potash imports dropped abruptly in 1938 to 193,609 short tons, a decrease of 157,836 tons (45 percent) from the all-time peak of 351,445 tons established in 1937. Fertilizer salts contained 93 percent of the potash imported, and salts imported for use in the chemical industries the remaining 7 percent.

The quantity, average grade, and total declared value of the various potash salts imported in 1937 and 1938, the countries from which shipments were made, and the approximate $K_2O$ equivalent of imports for the past 5 years are shown in the following tables.

*Potash materials imported for consumption in the United States, 1937–38*

| Material | Approximate equivalent as potash ($K_2O$) (percent) | 1937 | | | | 1938 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Short tons | Approximate equivalent as potash ($K_2O$) | | Value | Short tons | Approximate equivalent as potash ($K_2O$) | | Value |
| | | | Short tons | Percent of total | | | Short tons | Percent of total | |
| Used chiefly in fertilizers: | | | | | | | | | |
| Kainite | 14.0 | 974 | 136 | ------ | $7,238 | 402 | 56 | ------ | $2,528 |
| | 20.0 | 129,051 | 25,810 | 7.4 | 1,131,898 | 59,811 | 11,962 | 6.2 | 523,229 |
| Manure salts | 31.4 | 44,909 | 14,101 | 4.0 | 591,804 | 9,169 | 2,879 | 1.5 | 112,713 |
| Muriate (chloride) | 56.4 | 417,682 | 235,573 | 67.0 | 9,725,200 | 223,542 | 126,078 | 65.1 | 5,371,600 |
| Nitrate (saltpeter) (Chilean) | 14.0 | 61,271 | 8,578 | 2.5 | 1,309,386 | 44,493 | 6,229 | 3.2 | 971,646 |
| Potash - magnesia sulfate | 27.0 | 22,375 | 6,041 | 1.7 | 453,026 | 13,158 | 3,553 | 1.8 | 281,691 |
| Sulfate | 50.0 | 93,694 | 46,847 | 13.3 | 2,851,880 | 59,855 | 29,928 | 15.5 | 1,910,819 |
| Other potash fertilizer material [1] | 60.0 | 255 | 153 | .1 | 1,952 | 184 | 110 | .1 | 1,373 |
| Total fertilizer | ------- | 770,211 | 337,239 | 96.0 | 16,072,384 | 410,614 | 180,795 | 93.4 | 9,175,599 |
| Used chiefly in chemical industries: | | | | | | | | | |
| Bicarbonate | 46.0 | 206 | 95 | | 34,467 | 103 | 47 | | 17,334 |
| Bitartrate: | | | | | | | | | |
| Argols | 20.0 | 11,910 | 2,382 | | 1,699,328 | 15,873 | 3,175 | | 2,471,892 |
| Cream of tartar | 25.0 | (2) | (2) | | 9 | 18 | 5 | | 5,226 |
| Bromide | 39.6 | 2 | 1 | | 1,008 | (2) | (2) | | 30 |
| Carbonate | 61.0 | 788 | 481 | | 81,234 | 292 | 178 | | 30,981 |
| Caustic | 80.0 | 1,137 | 910 | | 167,857 | 486 | 389 | | 79,128 |
| Chlorate and perchlorate | 36.0 | 6,956 | 2,504 | | 585,470 | 6,848 | 2,465 | | 808,151 |
| Chromate and bichromate | 40.0 | (2) | (2) | | 330 | (2) | (2) | | 163 |
| Cyanide | 70.0 | 43 | 30 | 4.0 | 34,460 | 42 | 29 | 6.6 | 29,751 |
| Ferricyanide (red prussiate) | 42.0 | 189 | 79 | | 89,772 | 98 | 41 | | 42,814 |
| Ferrocyanide (yellow prussiate) | 44.0 | 56 | 25 | | 10,949 | 70 | 31 | | 12,780 |
| Iodide | 28.0 | (2) | (2) | | 42 | (2) | (2) | | 90 |
| Nitrate: | | | | | | | | | |
| Crude | 40.0 | 17,272 | 6,909 | | 761,764 | 14,648 | 5,859 | | 680,602 |
| Refined | 46.0 | 1,166 | 536 | | 93,024 | 1,042 | 479 | | 100,509 |
| Permanganate | 29.0 | 200 | 58 | | 38,910 | 49 | 14 | | 10,168 |
| All other | 50.0 | 393 | 196 | | 62,068 | 204 | 102 | | 46,892 |
| Total chemical | ------- | 40,318 | 14,206 | 4.0 | 3,660,692 | 39,773 | 12,814 | 6.6 | 4,336,511 |
| Grand total | ------- | 810,529 | 351,445 | 100.0 | 19,733,076 | 450,387 | 193,609 | 100.0 | 13,512,110 |

[1] Chiefly wood ashes from Canada.

[2] Less than 1 ton.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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*Potash materials imported for consumption in the United States in 1938, by countries, in short tons*

[Figures in parentheses in column headings indicate in percent approximate equivalent as potash ($K_2O$)]

| Country | 1938 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Muriate (chloride) (56.4) | Sulfate (50) | Potash-magnesia sulfate (27) | Manure salts (31.4) | Kainite (14) | Kainite (20) | Bitartrate: Argols or wine lees (20) | Bitartrate: Cream of tartar (25) | Caustic (80) | Carbonate (61) |
| Algeria | | | | | | | 3,525 | | | |
| Argentina | | | | | | | 828 | | | |
| Belgium | 9,823 | 2,372 | | 404 | | 1,281 | | | | |
| Bulgaria | | | | | | | | | | |
| Canada | 3,556 | 183 | 26 | | | | 2 | | | |
| Chile | | | | | | | 155 | | | |
| China | | | | | | | | | | 5 |
| Czechoslovakia | | | | | | | | | 2 | |
| France | 33,880 | 9,353 | | 1,656 | | 13,482 | 8,104 | | | |
| Germany | 110,125 | 39,260 | 13,132 | 4,480 | 402 | 32,188 | | | 418 | 215 |
| Greece | | | | | | | | | | |
| Hong Kong | | (1) | | | | | | | | 3 |
| Italy | | | | | | | 2,494 | 18 | | |
| Japan | | | | | | | | | | (1) |
| Morocco | | | | | | | 134 | | | |
| Netherlands | 36,458 | 8,687 | | 976 | | 12,860 | | | | 68 |
| Palestine | 10,256 | | | | | | | | | |
| Portugal | | | | | | | 387 | | | |
| Spain | 14,261 | | | 1,653 | | | 27 | | | |
| Sweden | 2 | | | | | | | | 66 | 1 |
| Switzerland | | | | | | | | | | |
| Tunisia | | | | | | | 217 | | | |
| U. S. S. R. | 5,181 | | | | | | | | | |
| United Kingdom | | | | | | | | | | |
| | 223,542 | 59,855 | 13,158 | 9,169 | 402 | 59,811 | 15,873 | 18 | 486 | 292 |

| Country | 1938—Continued | | | | | | Total 1937 | |
|---|---|---|---|---|---|---|---|---|
| | Cyanide (70) | Nitrate (saltpeter), crude (14 and 40) [2] | Chlorate and perchlorate (36) | All other (48) | Total: Short tons | Total: Value | Short tons | Value |
| Algeria | | | | | 3,525 | $500,279 | 1,824 | $238,513 |
| Argentina | | | | | 828 | 50,861 | 601 | 56,900 |
| Belgium | | | | | 13,880 | 312,137 | 41,930 | 845,514 |
| Bulgaria | | | | | | | 110 | 20,923 |
| Canada | | 588 | (1) | 183 | 4,538 | 129,059 | 7,293 | 210,033 |
| Chile | | 44,493 | | | 44,648 | 998,103 | 61,473 | 1,339,560 |
| China | | | | 1 | 6 | 856 | 3 | 439 |
| Czechoslovakia | | | | 41 | 43 | 8,999 | | |
| France | 2 | | 214 | 112 | 66,803 | 2,705,481 | 30,508 | 1,345,583 |
| Germany | 40 | 14,060 | 5,411 | 1,251 | 220,982 | 6,140,915 | 535,732 | 12,116,306 |
| Greece | | | | | | | 293 | 37,987 |
| Hong Kong | | | | | 3 | 286 | 11 | 1,247 |
| Italy | | | | | 2,512 | 422,225 | 3,686 | 540,165 |
| Japan | | | 193 | 7 | 200 | 12,867 | 67 | 7,806 |
| Morocco | | | | | 134 | 15,559 | 46 | 3,265 |
| Netherlands | | | | 104 | 59,153 | 1,291,732 | 114,514 | 2,433,183 |
| Palestine | | | | | 10,256 | 328,837 | 106 | 2,475 |
| Portugal | | | | | 387 | 51,969 | 286 | 45,827 |
| Spain | | | | | 15,941 | 225,774 | 58 | 6,093 |
| Sweden | | | 141 | | 210 | 40,878 | 428 | 77,238 |
| Switzerland | | | 889 | 3 | 892 | 89,371 | 641 | 69,053 |
| Tunisia | | | | | 217 | 24,030 | 192 | 17,145 |
| U. S. S. R. | | | | 25 | 5,206 | 148,838 | 10,693 | 303,429 |
| United Kingdom | | | | 23 | 23 | 13,054 | 34 | 14,392 |
| | 42 | 59,141 | 6,848 | 1,750 | 450,387 | 13,512,110 | 810,529 | 19,733,076 |

[1] Less than 1 ton. [2] Nitrate from Chile calculated at 14 percent $K_2O$, other countries 40 percent.

*Approximate equivalent as potash ($K_2O$) of potash-bearing materials imported for consumption in the United States, 1934–38, in short tons*

| | | | |
|---|---|---|---|
| 1934 | 171,955 | 1937 | 351,445 |
| 1935 | 241,510 | 1938 | 193,609 |
| 1936 | 211,752 | | |

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*Exports.*—Shipments of fertilizer salts to Japan, the largest buyer of American potash, were 28,000 tons less in 1938 than in 1937; and although exports to Canada and Europe expanded, the total was 18 percent below the 1937 figure. About 80 percent represented direct sales by producers and 10 percent resales from consumers' or speculators' stocks. Exports of chemical salts were slightly higher in 1938 than in 1937.

*Potash fertilizer materials exported from the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Austria | 72 | $2,318 | | |
| Belgium | 719 | 26,203 | 13,101 | $331,292 |
| Canada | 20,691 | 589,229 | 21,368 | 567,859 |
| Canary Islands | | | 560 | 7,500 |
| Czechoslovakia | 231 | 7,486 | | |
| Finland | 888 | 28,800 | | |
| Haiti | 1 | 65 | 56 | 1,745 |
| Honduras | 56 | 1,644 | 2 | 67 |
| Italy | 1,151 | 34,889 | | |
| Japan | 63,179 | 2,089,445 | 35,045 | 1,221,827 |
| Mexico | (1) | 10 | 20 | 805 |
| Mozambique | 28 | 1,000 | 3 | 116 |
| Netherlands | 2,687 | 85,539 | 1,856 | 66,360 |
| Norway | 1,958 | 63,802 | 4,740 | 153,050 |
| Philippine Islands | | | 658 | 21,428 |
| Sweden | 7,872 | 241,080 | 4,035 | 136,350 |
| Union of South Africa | 1,120 | 35,793 | 248 | 9,693 |
| United Kingdom | 594 | 18,857 | 822 | 30,207 |
| Venezuela | 45 | 1,642 | 112 | 4,497 |
| West Indies: | | | | |
| Barbados | 280 | 10,000 | 239 | 8,723 |
| Cuba | 1,048 | 27,589 | 1,100 | 32,007 |
| Other British | 283 | 9,091 | 168 | 6,085 |
| Yugoslavia | 110 | 3,516 | | |
| Other countries [2] | 18 | 897 | 4 | 161 |
| | 103,031 | 3,278,895 | 84,137 | 2,599,772 |

[1] Less than 1 ton. [2] Includes exports of less than 10 tons.

*Potassium salts (not fertilizer) exported from the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 2,121 | $466,929 | 1937 | 2,094 | $484,450 |
| 1935 | 3,641 | 637,473 | 1938 | 2,616 | 485,672 |
| 1936 | 2,333 | 487,347 | | | |

## WORLD PRODUCTION

The output of potash in marketable salts increased in all the leading producing countries except Spain in 1938. As already stated, shipments from Spain by the Loyalist Government are considered to have been drawn from stocks at Barcelona and not to represent new production. Although no authentic information is available it is believed that the Spanish mines, which were in Loyalist territory throughout the war, were not operated during 1938. Assuming an increase of 10,000 tons in Soviet output, world production rose 10 percent to a new high of 3,100,000 metric tons of $K_2O$ in crude and refined salts of marketable grade. The following table is based on estimates and available information from official and unofficial sources.

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*Approximate world production of potash in marketable salts, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Metric tons $K_2O$ | Percent of total | Metric tons $K_2O$ | Percent of total |
| Germany | 1,689,500 | 60.6 | 1,860,000 | 59.9 |
| France | 489,800 | 17.6 | 581,815 | 18.7 |
| United States | 258,090 | 9.2 | 287,532 | 9.3 |
| U. S. S. R. | 266,000 | 9.5 | 275,000 | 8.8 |
| Poland | 62,489 | 2.2 | 72,139 | 2.3 |
| Palestine | 18,234 | .7 | 24,000 | .8 |
| Other countries | 5,000 | .2 | 5,000 | .2 |
| | 2,789,000 | 100.0 | 3,105,500 | 100.0 |

Available official figures of world production are shown in the following table.

*World production of potash minerals and equivalent $K_2O$, 1935–38, by countries, in metric tons*

[Compiled by R. B. Miller]

| Country and mineral [1] | 1935 | | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|---|---|
| | Output | Equivalent $K_2O$ | Output | Equivalent $K_2O$ | Output | Equivalent $K_2O$ | Output | Equivalent $K_2O$ |
| North America: United States, potassium salts | 324,747 | 174,898 | 391,421 | 224,382 | 440,971 | 258,090 | 485,291 | 287,532 |
| Europe: | | | | | | | | |
| France (Alsace), crude potassium salts | 2,027,200 | [2] 347,270 | 2,123,540 | 368,880 | 2,383,494 | 489,781 | 3,374,801 | 581,815 |
| Germany, crude potassium salts: | | | | | | | | |
| Carnallite [3] | 1,371,604 | 139,057 | 1,415,731 | 145,160 | 1,672,417 | 170,550 | (4) | (4) |
| Kainite, sylvinite, and hartsalz | 10,300,905 | 1,457,915 | 10,348,821 | 1,477,490 | 12,787,735 | 1,797,866 | (4) | (4) |
| Italy, alunite | 2,092 | 251 | 3,976 | 477 | 3,500 | 420 | (4) | (4) |
| Poland, crude potassium salts: | | | | | | | | |
| Kainite | 81,593 | 8,159 | 89,187 | 8,919 | 111,357 | 11,136 | 547,467 | 106,028 |
| Sylvite | 288,091 | 63,380 | 336,317 | 73,990 | 395,885 | 87,095 | | |
| Langbeinite | 13,914 | 1,670 | 8,553 | 1,026 | 14,241 | 1,709 | 19,644 | 2,358 |
| Spain: | | | | | | | | |
| Crude potassium salts | 776,873 | 121,372 | (4) | (4) | (4) | (4) | (4) | (4) |
| U. S. S. R., crude potassium salts | 1,319,000 | 173,000 | 1,800,000 | 225,000 | 2,400,000 | 266,000 | (4) | (4) |
| Asia: | | | | | | | | |
| China, potassium carbonate [5] | 38 | (4) | 68 | (4) | (4) | (4) | (4) | (4) |
| Chosen, alunite | 81,510 | (4) | 114,569 | (4) | 149,000 | (4) | (4) | (4) |
| India (British), nitrate of potash [6] | 9,800 | 4,500 | 8,800 | 4,200 | 8,900 | 4,200 | (4) | (4) |
| Palestine, crude potassium salts [7] | 17,201 | 8,601 | 23,456 | 11,727 | 36,467 | 18,234 | [8] 47,496 | 24,000 |
| Africa: Eritrea, niccoli salts [9] | | | 300 | 80 | (4) | (4) | (4) | (4) |
| Australia, alunite | 579 | (4) | 758 | (4) | 339 | (4) | (4) | (4) |

[1] In addition to countries listed, Chile and Iran are reported to produce a small quantity of potash salts, but statistics of production are not available.
[2] Content of merchantable products.
[3] Includes some natural kieserite.
[4] Data not available.
[5] Exports.
[6] Estimated production (Imperial Institute, London).
[7] Extracted from waters of the Dead Sea.
[8] Exports of muriate of potash.
[9] Extracted from waters of the Red Sea.

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## FOREIGN DEVELOPMENTS

*British India.*—The American trade commissioner at Calcutta reports that the domestic production of potassium nitrate in British India was affected adversely by unfavorable weather and floods. Higher prices demanded caused substitution by consumers of synthetic nitrates, and exports fell to 7,387 tons from 8,357 tons in 1937.

*France.*—Output of crude salts from the French mines established a new record of 3,375,000 tons in 1938 that exceeded by 241,000 tons the previous record made in 1930. Sales also were greater than ever before, but because of the increased home demand producers were unable to supply their full export quota established by the International Cartel. Domestic prices have not been changed for a number of years, while costs have advanced because of social legislation and a generally rising commodity price level until there is little profit in domestic sales. The obligation to satisfy home demands before selling for export has prevented producers from taking full advantage of exchange conditions prevailing in other markets owing to depreciation of the franc. Sales in France are reported to have exceeded exports by about 18 percent. The potash mines are subject to Government control through the common sales agency established by the law of January 23, 1937, which has sole right of sale both at home and for export.

*Germany.*—More than 15,000,000 tons of crude potash salts averaging around 13.8 percent $K_2O$ were mined by German producers in 1938, the greatest mine output ever recorded in the history of the industry. The percentage of mine output sold as mined or mixed with refined salts to produce intermediate grades has been decreasing in recent years in line with the trend toward high-analysis fertilizers. From 85 to 90 percent is processed to produce muriate, sulfate, and other of the higher-grade salts to which market demand has shifted. In 1938 the mine output of approximately 15,000,000 tons was converted into 5,190,000 tons of salts of all marketable grades averaging 35.8 percent potash, equivalent to 1,860,000 tons of $K_2O$.

Mine output and marketable salts produced from 1932 to 1938 are stated in the following table.

*Production of potash salts in Germany, 1932–38*

[Thousands of metric tons]

| Year | Salts mined | | Marketable salts produced | |
|---|---|---|---|---|
| | Gross weight | Equivalent $K_2O$ | Gross weight | Equivalent $K_2O$ |
| 1932 | 6,416 | 871 | 2,801 | 787 |
| 1933 | 7,363 | 1,026 | 3,131 | 906 |
| 1934 | 9,617 | 1,329 | 4,175 | 1,179 |
| 1935 | 11,673 | 1,597 | 4,712 | 1,396 |
| 1936 | 11,765 | 1,623 | 4,734 | 1,441 |
| 1937 | 14,460 | 1,968 | 5,122 | 1,690 |
| 1938 | [1] 15,300 | [1] 2,114 | 5,190 | 1,860 |

[1] Estimated.

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Under Government pressure to increase crop production and measures to cheapen the cost of fertilizers, consumption of potash by German farmers has expanded rapidly in recent years. Domestic sales rose from 620,000 metric tons of $K_2O$ in the fertilizer year 1932–33 to 1,156,000 tons in the fertilizer year 1937–38, an increase of 86 percent in 5 years. However, Government-controlled prices have been maintained at an unprofitable level, and producers look to export business and expansion of byproduct manufacture to produce earnings for their stockholders. Notwithstanding rising sales, net profits, and dividend disbursements of the leading companies have declined steadily.

Exports in 1938 were sharply reduced from the 1937 level, owing mainly to smaller sales in two of the leading markets, the United States and Japan. Exports of raw potash salts declined only 10.5 percent to 698,546 metric tons, but exports of processed salts dropped 47 percent to 395,325 tons. The average value, in marks per metric ton, of raw salts exported rose from 39.38 in 1937 to 41.71 in 1938, but that of processed salts decreased from 68.87 in 1937 to 64.30 in 1938.

Increased demand for potash and more particularly for the processed salts has necessitated large expenditures in plant expansion and facilities for storing and handling the finished products. Wintershall A. G., the dominant factor in the potash industry that directly controlls 42 percent of the output, reports that in 1937 an investment of 31,000,000 marks was required for plant enlargement, purchase of new machinery, and plant improvements compared with 14,190,000 marks in 1936. Vice Consul G. M. Gerrity, attached to the American consulate general at Frankfort on the Main, states that the immense gains in national production of potash in recent times have resulted to only a moderate degree in increased earnings of German potash companies owing to the combined factor of heavy investments required for new plant equipment, uncertainties in the international trade and, since the spring of 1937, the Government's drastic reductions by around 25 percent of the fixed domestic prices of potash fertilizer. Thus, in spite of its heavily increased business, the Wintershall A. G. increased its net earnings only moderately in 1937—to 6,027,000 marks from 5,747,000 in 1936 and 5,710,000 marks in 1935. The company continued the 5-percent dividend upon its 125,000,000 marks of common stock, or the same rate in effect for the 2 preceding years.

The writer is indebted to American Consul Sydney B. Redecker and American Vice Consul G. M. Gerrity for general information and factual data on the German potash industry.

*Japan.*—According to the American commercial attaché at Tokyo, Japanese producers of potassium chlorate contend that changed conditions in China have made the international sales agreement of March 30, 1937, with European producers unworkable. The agreement, which allocated sales territories and export quotas, allotted all of Japan and Manchuria and 55 percent of the Chinese market to Japanese producers. Plans are being pushed to utilize bittern and sea water as the basis of a chemical and metallurgical industry. The production of metallic magnesium, aluminum, potassium chloride,

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sulfate and bromide, and ammonium sulfate is contemplated. The Japan Industrial Salt Co., Kobe Steel Manufacturing Co., and Meiji Mining Co. are interested in these projects.

*Poland.*—Mine production of crude potash salts in 1938 increased about 9 percent to 567,111 metric tons averaging 19 percent $K_2O$ equivalent to 108,380 tons of potash from 521,483 tons averaging 19 percent $K_2O$ equivalent to 99,940 tons of potash in 1937. Potash in marketable salts produced by refining and mixing the salts mined was reported to be 72,139 metric tons of $K_2O$ in 1938 compared with 62,489 tons in 1937. Stimulated by a price cut of 9 percent, sales of potash ($K_2O$) rose to 71,412 metric tons in 1938 from 64,605 tons in 1937. A slight reduction in Poland's export quota by the International Cartel was reported to have caused the decrease in exports of commercial potash salts from 84,803 metric tons in 1937 to 74,570 in 1938.

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# MICA

By Paul M. Tyler and K. G. Warner

SUMMARY OUTLINE


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World prices of mica were well-maintained in 1938 by the active foreign demand that continued almost unabated, especially in Europe; but in the United States, owing to curtailed consumption and the large stocks held by manufacturers, demand receded to depression levels. In comparison with 1937—a remarkably good year in almost every branch of the mica-manufacturing industries—1938 leaves a drab record. Domestic production of uncut mica decreased 45 percent in 1938 and of larger sheet sizes over 55 percent from the relatively high levels of the preceding year. The total yield of punch and sheet mica from American mines was less than in any but the worst years of the last three decades, amounting to only 939,507 pounds worth $139,333 compared with 1,694,538 pounds valued at $285,244 in 1937.

Domestic needs for the better qualities of mica, however, are supplied principally by imports, and the curtailed demand is shown further by the sharp reduction in receipts of foreign mica of all important kinds. Imports of sheet and block mica aggregated only 391,125 pounds with a nominal foreign market valuation of $113,403 compared with 1,004,950 pounds and $296,235 in 1937; the decrease in this category was more than 60 percent. In respect to splittings (the principal import item) the decrease was almost 75 percent, from 7,932,867 pounds valued at $1,598,969 in 1937 to 1,979,162 pounds valued at $445,323 in 1938. Domestic consumption of splittings reported to the Bureau of Mines decreased over 60 percent, and the large stocks carried over from 1937 were increased further.

Running counter to the general trend of the industry was the prosperity of the mica-grinding portion. Shipments of ground mica almost equaled the 1937 record in quantity and exceeded it by 10 percent in value. Increased demands for paint, wallpaper, and other miscellaneous uses more than offset a 13-percent reduction in the quantities used in roll roofing, which, however, took 70 percent of the total tonnage. Despite the activity of mica-grinding mills, their purchases of scrap declined in 1938, and since European buying is a minor factor in this market, prices of newly mined waste mica were greatly reduced.



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The total production of uncut sheet mica and scrap in the United States was 20,727 short tons valued at $395,715 in 1938 compared with 26,043 short tons valued at $639,981 in 1937 and 21,615 tons valued at $464,473 in 1936. Imports totaled 5,761 tons, nominally valued at $664,419 on a foreign market basis; in 1937 they aggregated 11,339 tons with a declared valuation of $2,067,599 and in 1936, 6,678 tons valued at $1,205,568. The foregoing figures for domestic and imported mica, respectively, make it appear that almost four times as much mica was produced in the United States as was imported in 1938. This is true in respect to total tonnage but actually the United States seldom produces as much as one-third of its requirements of sheet mica (larger than 1½ by 2 inches) and only a negligible amount of its requirements of splittings. The bulk of the domestic output is scrap, ground mica schist, and byproduct mica, although American mines also produce almost enough punch and circle mica—used for making washers and small radio stampings—to meet domestic needs.

For many years mica has been considered one of the few materials for which no acceptable substitute was available in many of its principal uses. Recent laboratory research indicates that a product (Alsifilm) made from bentonite may compete successfully with mica in the important electrical field, if it can be produced commercially. Another challenge to sheet mica and mica splittings may come from properly processed ground mica, though this development seems to be less far advanced than Alsifilm, which may be marketed on a semicommercial scale in 1939.

*Salient statistics of the mica industry in the United States, 1934–38*

| | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Domestic mica sold or used by producers: | | | | | |
| Total uncut sheet and punch: | | | | | |
| Pounds | 583,528 | 936,633 | 1,319,233 | 1,694,538 | 939,507 |
| Value | $90,268 | $161,150 | $203,879 | $285,244 | $139,333 |
| Average per pound | $0.15 | $0.17 | $0.15 | $0.17 | $0.15 |
| Scrap:[1] | | | | | |
| Short tons | 7,719 | 18,852 | 20,955 | 25,196 | 20,257 |
| Value | $99,791 | $243,951 | $260,594 | $354,737 | $256,382 |
| Average per ton | $12.93 | $12.94 | $12.44 | $14.08 | $12.66 |
| Total sheet and scrap:[1] | | | | | |
| Short tons | 8,011 | 19,320 | 21,615 | 26,043 | 20,727 |
| Value | $190,059 | $405,101 | $464,473 | $639,981 | $395,715 |
| Total ground:[1] | | | | | |
| Short tons | 9,547 | 18,323 | 25,585 | 27,245 | 27,086 |
| Value | $403,330 | $542,973 | $722,416 | $839,812 | $924,554 |
| Consumption of splittings:[2] | | | | | |
| Pounds | 1,763,035 | 2,532,984 | 3,518,058 | 4,347,435 | 1,667,806 |
| Value | $490,148 | $631,065 | $846,393 | $1,257,645 | $612,465 |
| Imports for consumption: | | | | | |
| Unmanufactured: | | | | | |
| Short tons | 3,844 | 3,290 | 4,323 | 7,226 | 4,646 |
| Value | $247,408 | $211,556 | $262,044 | $332,590 | $141,993 |
| Manufactured: | | | | | |
| Short tons | 1,272 | 1,588 | 2,355 | 4,113 | 1,115 |
| Value | $515,214 | $696,828 | $943,524 | $1,735,009 | $522,426 |
| Total imports: | | | | | |
| Short tons | 5,116 | 4,878 | 6,678 | 11,339 | 5,761 |
| Value | $762,622 | $908,384 | $1,205,568 | $2,067,599 | $664,419 |
| Exports (all classes of mica): | | | | | |
| Short tons | 1,751 | 1,499 | 1,478 | 1,795 | 1,772 |
| Value | $188,525 | $165,385 | $170,011 | $216,858 | $183,889 |

[1] Includes byproduct mica recovered in washing kaolin and, beginning in 1935, mica recovered by milling mica schists, as follows: 1935, 6,667 short tons valued at $111,345; 1936, 8,258 tons, $127,343; 1937, 10,536 tons, $149,931; 1938, 6,550 tons, $86,602.

[2] Exclusive of a nominal quantity of splittings produced in South America and the United States.

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## DOMESTIC PRODUCTION

*Sheet mica.*—Mica seems to have been the first mineral mined in North America. Thousands of tons of debris on the dumps testify to the extent of the ancient workings operated by western North Carolina aborigines. The mica ornaments left by Ohio Valley mound builders likewise confirm the importance of this mineral to primitive peoples, who prized it chiefly as a decoration and perhaps as a medicine and a charm.

The first mica mine to be operated on a commercial scale in this country was probably the Ruggles, in New Hampshire, which was opened in 1803 to provide "isinglass" for stove windows. It is said also to have furnished sheets for gunboat windows, because gunfire would shatter ordinary glass. As the demand for mica developed very slowly early production in New Hampshire was only sporadic; mining on a relatively stable basis was started in 1868 in North Carolina. Since that date the latter State ordinarily has been the leading producer, occasionally alternating with New Hampshire and possibly yielding first rank to South Dakota for a year or two.

Production statistics on mica have been published annually since 1880, when the output of American mines was 81,669 pounds valued at $127,825. After rising to 147,410 pounds worth $368,525 in 1884 it dwindled rapidly owing to the competition of Indian mica, which was imported first in 1885. The rapid growth of the electrical industry during the 1890's so increased the demand for sheet mica that in 1898 domestic output once more rose above 100,000 pounds and at the turn of the century jumped to 456,283 pounds valued, however, at only $92,758. By 1906 the output had grown to 1,423,100 pounds with a value of $252,248. In 1910 it attained a peak of 2,476,190 pounds—but this was mostly small mica, as the value was only $283,832 whereas the 1,700,677 pounds produced in 1913 was worth $353,517.

In the earlier years some mica miners operated cutting plants; and the value of their finished products, such as stove mica and other more or less standard sizes, was included in the production statistics. Since 1920, however, the production as officially reported comprises uncut sheet mica alone. Beginning with 1920 also, separate figures have been compiled for uncut "punch" and uncut sheet larger than punch. "Punch mica" is a domestic term not generally used abroad and refers to crystals of book or block mica, usually thumb-trimmed, as opposed to knife- or shear-trimmed, but not large enough to furnish sheets more than about 1½ inches in diameter. Included with punch mica is circle mica, which is somewhat larger, yielding circles up to 2 inches in diameter.

*Scrap mica.*—The United States probably consumes 90 percent of the scrap and waste mica used. It is the only country that has a large demand for ground mica or that has had long and successful experience in grinding mica, which is one of the most difficult minerals to grind without destroying certain of its useful properties.

Separate statistics covering domestic mine production of scrap mica have been available continuously since 1893, when an output of 156 tons was recorded. In 1900 the output soared to 5,497 tons valued at $55,202, but this was abnormal and the annual average for the 5-year pre-war period, 1909–1913, was 4,043 tons valued at $55,296. The annual average for the predepression period, 1925–29, was 7,406

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tons valued at $134,128, thus showing an increase of 85 percent in less than two decades. The actual rise was even greater, because a substantial recovery of mica from clay washing as well as production from schists had been developed. These items, amounting to 6,667 short tons valued at $111,345, were included in the statistics for 1935 when the total production of scrap, ground mica schist, and byproduct mica advanced to 18,852 tons valued at $243,951. Later figures are shown in the accompanying table.

*Mica sold or used by producers in the United States, 1925–38*

| Year | Sheet mica | | | | | | Scrap mica | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Uncut punch and circle mica | | Uncut mica larger than punch and circle | | Total uncut sheet mica | | | | | |
| | Pounds | Value | Pounds | Value | Pounds | Value | Short tons | Value | Short tons | Value |
| 1925–29 (average) | 1,433,684 | $117,702 | 405,400 | $172,679 | 1,839,084 | $290,381 | 7,406 | $134,128 | 8,326 | $424,509 |
| 1930–34 (average) | 589,668 | 25,764 | 153,433 | 69,930 | 743,101 | 95,694 | 7,373 | 98,048 | 7,744 | 193,742 |
| 1935 | 670,327 | 28,387 | 266,306 | 132,763 | 936,633 | 161,150 | [1] 18,852 | [1] 243,951 | [1] 19,320 | [1] 405,101 |
| 1936 | 1,018,460 | 48,386 | 300,773 | 155,493 | 1,319,233 | 203,879 | [1] 20,955 | [1] 260,594 | [1] 21,615 | [1] 464,473 |
| 1937: | | | | | | | | | | |
| Connecticut | 311,091 | 12,242 | 90,720 | 31,046 | 401,811 | 43,288 | 561 | 8,616 | 762 | 51,904 |
| New Hampshire | 195,429 | 8,517 | 39,626 | 11,602 | 235,055 | 20,119 | 306 | 4,397 | 423 | 24,516 |
| North Carolina | 795,684 | 46,688 | 248,644 | 171,488 | 1,044,328 | 218,176 | [2] 12,988 | [2] 209,212 | [2] 13,510 | [2] 427,388 |
| Other States [3] | 10,696 | 3,046 | 2,648 | 615 | 13,344 | 3,661 | [4] 11,341 | [4] 132,512 | [4] 11,348 | [4] 136,173 |
| | 1,312,900 | 70,493 | 381,638 | 214,751 | 1,694,538 | 285,244 | [1] 25,196 | [1] 354,737 | [1] 26,043 | [1] 639,981 |
| 1938: | | | | | | | | | | |
| Connecticut | (5) | (5) | (5) | (5) | (5) | (5) | (5) | (5) | (5) | (5) |
| New Hampshire | 200,708 | 8,820 | 82,128 | 40,434 | 282,836 | 49,254 | 927 | 16,189 | 1,069 | 65,443 |
| North Carolina | 552,471 | 35,885 | 80,175 | 51,994 | 632,646 | 87,879 | [2] 11,959 | [2] 161,598 | [2] 12,275 | 249,477 |
| Other States [3] | 20,942 | 861 | 3,083 | 1,339 | 24,025 | 2,200 | [4] 7,371 | [4] 78,595 | [4] 7,383 | [4] 80,795 |
| | 774,121 | 45,566 | 165,386 | 93,767 | 939,507 | 139,333 | [1] 20,257 | [1] 256,382 | [1] 20,727 | [1] 395,715 |

[1] Includes mica recovered from kaolin and schists as follows: 1935, 6,667 short tons valued at $111,345; 1936, 8,258 tons, $127,343; 1937, 10,536 tons, $149,931; 1938, 6,550 tons, $86,602.
[2] Includes mica recovered from kaolin and schists as follows: 1937, 5,115 short tons valued at $90,994; 1938, 3,971 tons, $64,542.
[3] 1937: Arizona, California, Colorado, Georgia, Maine, New Mexico, South Carolina, South Dakota, Utah, and Virginia. 1938: Arizona, California, Colorado, Georgia, Maine, New Mexico, South Carolina, South Dakota, Virginia, and Wyoming.
[4] Includes mica recovered from kaolin and schists as follows: 1937, 5,421 short tons valued at $58,937; 1938, 2,579 tons, $22,060.
[5] Connecticut included with New Hampshire.

*Ground mica.*—The earlier data for ground mica are as incomplete as those for scrap mica, in that they likewise fail to include byproduct mica and ground schist mica. Reclaimed mica from clay washing competes with dry-ground mica in the important roofing market, but because it ordinarily does not have to be ground it was excluded from the statistics until 1930. Schist mica, which was produced in fairly large amounts as early as 1923 and to some extent even earlier, was excluded until 5 years later. Beginning with 1935, however, the Bureau of Mines has reported as "ground mica" all classes of material—including wet- and dry-ground muscovite, mica recovered from clay washing, byproduct mica from kyanite or other concentrating operations, and the product of milling schists (whether muscovite, sericite, biotite, or even chlorite schist). In addition to domestic raw material several grinding plants use foreign mica,

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both imported mine scrap and factory scrap from the manufacture of products of imported sheet mica and splittings.

The true growth of the ground-mica industry is portrayed faithfully in the official production figures, even though they are slightly distorted for a decade or two by the aforementioned statistical details. After fluctuating for many years between 3,000 and 4,000 short tons the annual output about 1925 began to rise rapidly, reaching 18,323 tons in 1935 and continuing upward to a new all-time record of 27,245 tons valued at $839,812 in 1937.

*Ground mica sold by producers in the United States, 1925–38, by methods of grinding*

| Year | Dry-ground | | Wet-ground | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1925–29 (average) | 2,436 | $89,624 | 2,821 | $301,122 | 5,257 | $390,746 |
| 1930–34 (average) | 5,967 | 155,471 | 2,517 | 224,838 | 8,484 | 380,309 |
| 1935 | [1] 15,178 | [1] 341,825 | 3,145 | 201,148 | [1] 18,323 | [1] 542,973 |
| 1936 | [1] 20,800 | [1] 457,042 | 4,785 | 265,374 | [1] 25,585 | [1] 722,416 |
| 1937 | [1] 21,150 | [1] 457,879 | 6,095 | 381,933 | [1] 27,245 | [1] 839,812 |
| 1938 | [1] 19,757 | [1] 466,959 | 7,329 | 457,595 | [1] 27,086 | [1] 924,554 |

[1] Includes mica from kaolin and schist.

Especially notable in 1938 were the substantial increases in sales of wet-ground mica for wallpaper and for paint. Although the paint industry even yet takes only 6 percent of the total sales its consumption was more than half again as large in 1938 as in 1937 and many times larger than in any year before 1936. There was an even more remarkable increase in shipments for miscellaneous uses. This category includes a considerable tonnage sold for an undisclosed "new use," but consumption for several other uses also rose sharply. These increases almost counterbalanced the 13-percent decrease in sales for roll roofing, still the principal use, and contributed to the 10-percent increase in the value of the total output.

*Ground mica sold to various industries in the United States, 1937–38*

| Industry | 1937 | | | 1938 | | |
|---|---|---|---|---|---|---|
| | Quantity | | Value | Quantity | | Value |
| | Short tons | Percent of total | | Short tons | Percent of total | |
| Roofing [1] | 21,636 | 79 | $457,652 | 18,795 | 70 | $402,671 |
| Wall paper | 2,623 | 10 | 190,127 | 2,926 | 11 | 232,870 |
| Rubber | 1,413 | 5 | 99,106 | 1,187 | 4 | 82,809 |
| Paint | 1,011 | 4 | 69,125 | 1,666 | 6 | 117,595 |
| Miscellaneous [2] | 562 | 2 | 23,802 | 2,512 | 9 | 88,609 |
| | 27,245 | 100 | 839,812 | 27,086 | 100 | 924,554 |

[1] Includes mica from kaolin and schist.
[2] Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipe-line enamel, plastic specialties, textiles, pipe and boiler covering, coating levee mattresses, and other purposes.

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Mica filler is employed principally to increase the dielectric properties of molded plastics, especially molded phenolic resins for electrical uses; it is also used in rubber. The potential use of ground mica is enormous. It may be used advantageously to the extent of 10 percent of the total pigment in paints and universal adoption by the paint industry would afford a market for as much as 100,000 tons annually. A possible competitor in this field is a new pigment developed by the Universal Insulation Co., Chicago, Ill., intermediate in composition between vermiculite and mica.

## CONSUMPTION AND STOCKS OF SPLITTINGS

After expanding steadily for 5 years to an all-time record in 1937 the consumption of mica splittings contracted sharply in 1938 to 1,667,806 pounds with a value of only $612,465 compared with 4,347,435 pounds worth $1,257,645 in the preceding year. The consumption in 1938 was the smallest since 1933, but stocks in consumers' hands increased by 7 percent above the abnormally heavy inventories carried over from 1937 and at the close of the year were three times as large as at the end of 1936.

Indian muscovite splittings still constitute more than 85 percent of the total consumed; however, Madagascar splittings now represent over 10 percent and have become more than twice as important as those from Canada, which enjoyed a monopoly of the amber-mica business until about 1919. Occasional batches of splittings are reported as produced by domestic mines and trimming or sorting plants, and small amounts are made in the United States from imported mica, but the aggregate quantity of American-made splittings is virtually negligible.

*Consumption and stocks of mica splittings in the United States, 1934–38, by sources, as reported by the consumers*

| Year | India | | Canada | | Madagascar | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value |
| Consumption:[1] | | | | | | | | |
| 1934 | 1,423,635 | $350,561 | 94,422 | $37,903 | 244,978 | $101,684 | 1,763,035 | $490,148 |
| 1935 | 2,150,593 | 492,161 | 129,272 | 42,897 | 253,119 | 96,007 | 2,532,984 | 631,065 |
| 1936 | 3,051,824 | 649,982 | 102,766 | 44,566 | 363,468 | 151,845 | 3,518,058 | 846,393 |
| 1937 | 3,721,594 | 965,418 | 98,618 | 51,960 | 527,223 | 240,267 | 4,347,435 | 1,257,645 |
| 1938 | 1,446,349 | 511,674 | 41,100 | 20,401 | 180,357 | 80,390 | 1,667,806 | 612,465 |
| Stocks in consumers' hands Dec. 31: | | | | | | | | |
| 1934 | 924,028 | 240,792 | 200,018 | 80,976 | 208,354 | 82,809 | 1,332,400 | 404,577 |
| 1935 | 1,011,864 | 259,201 | 139,019 | 57,286 | 213,421 | 82,908 | 1,364,304 | 399,395 |
| 1936 | 1,280,517 | 304,036 | 52,014 | 19,048 | 223,357 | 101,711 | 1,555,888 | 424,795 |
| 1937 | 3,920,730 | 1,094,414 | 77,130 | 33,722 | 444,762 | 195,976 | 4,442,622 | 1,324,112 |
| 1938 | 4,057,681 | 1,128,075 | 55,827 | 24,378 | 631,119 | 273,926 | 4,744,627 | 1,426,379 |

[1] Exclusive of a nominal quantity of splittings produced in South America and the United States.

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## PRICES

Mica is marketed as (1) cut or uncut block, (2) sheet, (3) splittings, and (4) wet- or dry-ground, but the value depends on the size of flat sheets into which it can be split and on whether it is clear or stained. The complexity of grading and classifying sheet mica is indicated by the fact that at least 100 distinct products can be classed as unmanufactured mica. Not only do the sheets vary enormously in size, but for each size there are at least six different qualities ranging from clear to black-stained. To attempt to report prices of all these different grades (sizes) and classes (qualities) year after year would be an endless task and one that would reveal little beyond the general trend toward relatively higher prices for smaller sizes.

Trade-journal quotations for domestic mica in 1938 were about the same as in 1937 and did not differ greatly from those reported for the latter part of 1936 and tabulated on page 1405 of Minerals Yearbook 1937. Actual prices paid for specified sizes in 1938 as reported to the Bureau of Mines by producers are shown in the following table.

*Average value per pound of domestic uncut sheet mica sold in 1938*

| Size | Clear | Stained or spotted | Size | Clear | Stained or spotted |
|---|---|---|---|---|---|
| Punch or washer | $0.056 | $0.055 | 3 by 4 inches | $1.329 | $0.870 |
| Circle | .103 | .151 | 3 by 5 inches | 1.752 | 1.099 |
| 1½ by 2 inches | .262 | .199 | 4 by 6 inches | 2.758 | 1.353 |
| 2 by 2 inches | .510 | .243 | 6 by 8 inches | 4.127 | 1.495 |
| 2 by 3 inches | .871 | .451 | 8 by 10 inches | 8.394 | 1.297 |
| 3 by 3 inches | 1.103 | .630 | 10 by 12 inches | 9.429 | ---------- |

## FOREIGN TRADE [1]

*Imports.*—In 1938 the imports of mica aggregated only 5,761 short tons, compared with 11,339 tons in 1937. Moreover, whereas the quantity imported was roughly one-half the total for the preceding year, the declared value in 1938 was less than one-third. Imports of scrap mica were not listed separately before June 18, 1930, but it is generally conceded that they were unimportant until the late 1920's. They increased to 3,893 short tons in 1936 and to 6,723 tons in 1937. In 1938 they dropped to 4,450 tons; but as the imports of mica other than scrap dropped far more, the proportion of scrap to total imports was greater in that year than ever before. The chief value of the imports is in splittings, imports of which were reduced sharply because of the great curtailment in consumption and the large stocks already on hand. For many years the trend has been to use larger proportions of the lower-priced kinds of mica, and in 1938 the shrinkage in imports affected most of the higher-priced grades. Less unmanufactured sheet or block mica was imported in 1938 than in any year since 1932.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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*Mica imported for consumption in the United States in 1938, by kinds and by countries*

| Country | Unmanufactured | | | | | | | | Total unmanufactured | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Waste and scrap, valued at not more than 5 cents per pound (duty, 25 percent) | | Untrimmed Phlogopite mica from which no rectangular piece exceeding in size 1 inch, by 2 inches may be cut (duty, 15 percent) | | Other | | | | | |
| | | | | | Valued at not above 15 cents per pound (duty, 4 cents per pound) | | Valued above 15 cents per pound (duty, 4 cents per pound +25 percent) | | | |
| | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value |
| Africa: | | | | | | | | | | |
| Madagascar | | | | | 881 | $104 | 1,921 | $2,025 | 2,802 | $2,129 |
| Union of South Africa | 1,473,550 | $6,282 | | | | | | | 1,473,550 | 6,282 |
| Argentina | | | | | 11,948 | 1,527 | 13,685 | 6,079 | 25,633 | 7,606 |
| Brazil | 2,200 | 15 | | | 74,707 | 9,207 | 76,666 | 28,714 | 153,573 | 37,936 |
| Canada | 1,084,360 | 4,962 | 100 | $12 | 15,966 | 1,386 | 4,095 | 2,253 | 1,104,521 | 8,613 |
| France | | | | | | | 1,924 | 2,688 | 1,924 | 2,688 |
| India, British | 6,340,848 | 17,331 | | | 6,681 | 852 | 175,930 | 54,853 | 6,523,459 | 73,036 |
| United Kingdom | | | | | 523 | 71 | 6,098 | 3,632 | 6,621 | 3,703 |
| Total: 1938 | 8,900,958 | 28,590 | 100 | 12 | 110,706 | 13,147 | 280,319 | 100,244 | 9,292,083 | 141,993 |
| 1937 | 13,446,411 | 36,355 | 89,230 | 9,091 | 323,742 | 38,189 | 591,978 | 248,955 | 14,451,361 | 332,590 |

| Country | Manufactured (films and splittings) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Not cut or stamped to dimensions | | | | Cut or stamped to dimensions (duty, 45 percent) | | Total films and splittings | |
| | Not above 12 ten-thousandths of an inch in thickness (duty, 25 percent) | | Over 12 ten-thousandths of an inch in thickness (duty, 40 percent) | | | | | |
| | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value |
| Africa: Madagascar | 239,483 | $47,740 | | | | | 239,483 | $47,740 |
| Brazil | 65 | 24 | 1,570 | $715 | | | 1,635 | 739 |
| Canada | 13,304 | 5,730 | 927 | 266 | | | 14,231 | 5,996 |
| France | 588 | 238 | | | | | 588 | 238 |
| India, British | 1,571,926 | 318,546 | 143,500 | 66,616 | 7,360 | $5,074 | 1,722,786 | 390,236 |
| United Kingdom | 154 | 34 | 185 | 231 | 100 | 109 | 439 | 374 |
| Total: 1938 | 1,825,520 | 372,312 | 146,182 | 67,828 | 7,460 | 5,183 | 1,979,162 | 445,323 |
| 1937 | 7,551,999 | 1,443,083 | 371,353 | 140,695 | 9,515 | 15,191 | 7,932,867 | 1,598,969 |

| Country | Manufactured (cut or stamped to dimensions, shape, or form) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Cut (duty, 40 percent) | | Disks (duty, 40 percent) | | Other (duty, 40 percent) | | Total cut or stamped | |
| | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value |
| Brazil | 165 | $318 | | | | | 165 | $318 |
| Canada | 304 | 188 | | | 3,064 | $1,492 | 3,368 | 1,680 |
| Germany | 6,478 | 6,638 | | | | | 6,478 | 6,638 |
| India, British | 22,917 | 28,450 | 10,071 | $5,273 | 355 | 808 | 33,343 | 34,531 |
| United Kingdom | 174 | 1,286 | | | 410 | 473 | 584 | 1,759 |
| Total: 1938 | 30,038 | 36,880 | 10,071 | 5,273 | 3,829 | 2,773 | 43,938 | 44,926 |
| 1937 | 122,848 | 61,330 | 14,850 | 8,841 | 1,075 | 639 | 138,773 | 70,810 |

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*Mica imported for consumption in the United States in 1938, by kinds and by countries*—Continued

| Country | Manufactured (other) | | | | Total manufactured | |
|---|---|---|---|---|---|---|
| | Mica plates and built-up mica (duty, 40 percent) | | Ground or pulverized | | | |
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Africa: Madagascar | | | | | 239,483 | $47,740 |
| Brazil | | | | | 1,800 | 1,057 |
| Canada | 18,965 | $18,500 | | | 36,564 | 26,176 |
| France | | | | | 588 | 238 |
| Germany | | | 169,025 | $2,626 | 175,503 | 9,264 |
| India, British | | | | | 1,756,129 | 424,767 |
| United Kingdom | 18,551 | 11,051 | | | 19,574 | 13,184 |
| Total: 1938 | 37,516 | 29,551 | 169,025 | 2,626 | 2,229,641 | 522,426 |
| 1937 | 67,307 | 60,240 | 82,200 | 1,233 | [1] 8,226,786 | [1] 1,735,009 |

[1] Includes 5,639 pounds valued at $3,757 of "All manufactures of which mica is the component material of chief value," no imports of which are shown in 1938.

As usual, British India was the principal source of imported scrap mica as well as of splittings and the more costly kinds of unmanufactured mica. Madagascar has become the second leading source of splittings, while Canada has fallen to a poor third. In 1938 the Union of South Africa displaced Canada from second place, even as a supplier of scrap. South American countries are increasingly important sources of block mica.

Under the reciprocal trade agreement with Canada, effective January 1, 1939, the duty on imported phlogopite mica waste and scrap valued at not more than 5 cents per pound was reduced from 25 percent ad valorem to 15 percent, and the duty on punch-size phlogopite (untrimmed) was lowered from 15 percent to 10 percent. Imports from Canada are amber mica or phlogopite, whereas those from all but one other country are muscovite. Madagascar, the only other producer of phlogopite, has never shipped scrap mica. The Canadian agreement also cut the duty on ground mica from 20 to 15 percent ad valorem. In discussing this latter change the Tariff Commission notes that although small quantities of mica are ground in other countries (Great Britain, Germany, France, and Japan), their combined output totals only a few hundred tons annually and the United States is on an export basis. Duties on other kinds of mica remain the same as in the original tariff act of 1930.

*Exports.*—Separate statistics of exports of ground mica became available for the first time in 1937, when they amounted to 1,532 tons, probably a record. The 1938 exports of 1,394 tons (worth $103,651) compare favorably with estimated foreign sales during the 1925–29 period and undoubtedly are greater than those for most years. The decline from the 1937 peak was due mainly to decreased shipments to Canada; shipments to United Kingdom, the largest buyer, increased slightly. Exports of unmanufactured mica increased by 139 tons but are unimportant. The shipments of manufactures other than ground mica, totaling 50,445 pounds valued at $75,379 in 1938, compare with 98,026 pounds and a value of $104,792 in the preceding year. This classification comprises principally repairs and replacements for American-made machinery and electrical apparatus.



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*Mica and manufactures of mica exported from the United States in 1938, by countries*

| Country | Unmanufactured | | Ground or pulverized | | Other | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| North America: | | | | | | |
| Canada | 420,639 | $2,142 | 393,681 | $15,089 | 30,683 | $42,738 |
| Cuba | | | 449 | 26 | 737 | 1,196 |
| Mexico | | | 13,821 | 590 | 1,713 | 2,250 |
| Other North America | 500 | 10 | | | 881 | 2,163 |
| South America: | | | | | | |
| Argentina | | | 11,185 | 561 | 1,769 | 1,388 |
| Brazil | | | | | 4,356 | 5,227 |
| Chile | | | 50 | 2 | 427 | 1,636 |
| Venezuela | | | 41,370 | 1,021 | 166 | 469 |
| Other South America | | | | | 956 | 1,112 |
| Europe: | | | | | | |
| Belgium | | | 394,195 | 14,339 | 2,886 | 7,412 |
| France | | | 25,557 | 1,065 | 210 | 619 |
| Germany | 2,418 | 139 | 474,912 | 17,658 | | |
| Netherlands | | | 40,022 | 1,534 | 1,202 | 2,018 |
| United Kingdom | 202,240 | 1,768 | 1,290,589 | 47,863 | 192 | 614 |
| Other Europe | | | 77,752 | 2,689 | 1,880 | 2,849 |
| Asia: | | | | | | |
| China | | | 400 | 27 | 50 | 100 |
| India, British | 80,000 | 800 | | | 500 | 1,034 |
| Netherland India | | | 11,600 | 521 | 210 | 186 |
| Other Asia | | | | | 319 | 629 |
| Africa | | | 3,605 | 145 | 303 | 927 |
| Australia | | | 8,600 | 521 | 1,005 | 812 |
| Total: 1938 | 705,797 | 4,859 | 2,787,788 | 103,651 | 50,445 | 75,379 |
| 1937 | 427,381 | 3,895 | 3,064,869 | 108,171 | 98,026 | 104,792 |

## WORLD PRODUCTION

*World production of mica, 1934–38, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| North America: | | | | | |
| Canada (sales) | 905 | 570 | 726 | 857 | 342 |
| United States (sold or used by producers) | 7,267 | [1] 17,527 | [1] 19,609 | [1] 23,626 | [1] 18,803 |
| South America: | | | | | |
| Argentina [2] | 175 | 225 | 210 | (3) | (3) |
| Bolivia [4] | 4 | 2 | 9 | | 4 |
| Brazil [4] | 59 | 110 | 237 | 330 | 521 |
| Peru | | | | 5 | 22 |
| Europe: | | | | | |
| Italy | 5 | 34 | 12 | 24 | (3) |
| Norway [4] | 170 | 56 | 43 | 42 | (3) |
| Rumania | | 20 | 67 | 26 | (3) |
| Sweden | 16 | 32 | 125 | 68 | (3) |
| U. S. S. R. | (5) | (5) | (3) | (3) | (3) |
| Asia: | | | | | |
| Ceylon [4] | (6) | 2 | (6) | 1 | (6) |
| Chosen | 103 | 87 | 70 | [7] 70 | (3) |
| India, British [8] | 4,720 | 7,204 | 9,026 | 15,106 | 13,633 |
| U. S. S. R. | [5] 4,433 | [5] 8,274 | (3) | (3) | (3) |
| Africa: | | | | | |
| Eritrea | | | 4 | (3) | (3) |
| Madagascar [9] | 294 | 522 | 410 | 583 | (3) |
| Nigeria | | | | | 3 |
| Rhodesia: | | | | | |
| Northern | 1 | 2 | 3 | 4 | 4 |
| Southern | 2 | 4 | 9 | 17 | 13 |
| Tanganyika Territory | 31 | 47 | 44 | 71 | (3) |
| Union of South Africa (Transvaal) | 630 | 582 | 495 | 1,740 | 1,161 |
| Oceania: | | | | | |
| Australia: | | | | | |
| New South Wales | 91 | | | | (3) |
| Northern Territory (Central Australia) | 49 | 44 | 21 | 42 | (3) |
| South Australia | | | | 43 | (3) |

[1] Includes following quantities recovered from kaolin and schists: 1935, 6,048 tons; 1936, 7,491 tons; 1937, 9,558 tons; 1938, 5,942 tons.
[2] Rail and river shipments.
[3] Data not available.
[4] Exports.
[5] Output of U. S. S. R. in Europe included under U. S. S. R. in Asia.
[6] Less than 1 ton.
[7] Official estimate.
[8] Exports; the figures for output are incomplete, and a more accurate idea of the size of the industry can be obtained from the export figures (Rec. Geol. Survey of India, vol. 59, pt. 3, p. 273, Calcutta, 1926). Output in 1934, 2,830 tons; 1935, 2,985 tons; 1936, 4,423 tons; 1937, 5,308 tons.
[9] Exports reported as follows: 1934, 369 tons; 1935, 409 tons; 1936, 452 tons; 1937, 611 tons; 1938, 626 tons.

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## SUBVARIETIES OF MUSCOVITE

Volk,[2] after studying the optical and chemical properties of 22 samples of muscovite from all over the world, recommends three subdivisions: Potassium muscovite ($H_4K_2Al_6Si_6O_{24}$); phengite ($H_6K_2(Fe, Mg)_2Al_4Si_6O_{24}$); and ferric iron muscovite ($H_4K_2Fe_2'''Al_4Si_6O_{24}$). His formula for phengite differs from the old one, as it contains 1 more molecule of $H_2O$ and FeO or MgO and 1 less of $SiO_2$. In all three subvarieties the ratio of $R_2O$ ($K_2O$ and $Na_2O$) to $SiO_2$ is 1 to 6. Ferric iron muscovite, when present in the system, increases the refractive index.

## POSSIBLE SUBSTITUTES FOR MICA

The long quest for substitutes for mica in its principal electrical uses so far has been futile. No other substance combines many of mica's useful attributes. To escape dependence on large, unflawed sheets, which are rare in nature and hence costly, smaller sheets have been pasted or eyeletted together, and a fairly large industry has been established for making built-up mica from splittings. The built-up-mica industry, however, and the highly important fields that it serves have made the world more dependent than ever on British India for its mica. Not only has that country the largest mica mines, but it is one of the few countries where skilled labor is still cheap enough to permit splitting mica into thin films economically. Small books of mica that in the United States would be counted as waste fit only for grinding are converted laboriously into splittings in India. It is these splittings that are assembled and bonded—often with shellac, another Indian specialty—into built-up sheets or board, whether in the United States, England, Germany, France, or Japan.

Many years ago a large American company developed a substitute for built-up mica in commutator segments, and some of the electrical machinery in which it was used is still in satisfactory service. However, the material, which contained asbestos as an essential ingredient, tended to develop cracks after some time and so was abandoned. "Mycalex" is an important type of electrical insulation made by bonding coarsely ground mica with lead borate or soft glass; it competes with porcelain but not with sheet mica or mica board.

As noted in the introduction to this chapter, in 1938 there appeared a new material that promises to compete with sheet mica and perhaps displace mica board for a variety of electrical purposes. It may have an even better field of use to replace existing varieties of insulating tapes, including those made from high-grade pan-packed mica splittings. This material, called "Alsifilm," was developed in the laboratories of Dr. Ernst A. Hauser, Massachusetts Institute of Technology chemistry professor. It is processed from bentonite, and available information as to its properties and methods of production is summarized in the Minerals Yearbook 1939 chapter on Clays.

The other new development is the possible use of ground mica for certain applications of sheet mica or splittings. Japan is rumored to have made advances in this field, and an American inventor recently applied for patents and disclosed his plans to Bureau of Mines engineers.

[2] Volk, G. W., Optical and Chemical Studies of Muscovite: Am. Mineral., vol. 24, No. 4, April 1939, pp. 255-266.

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# SALT

By A. T. Coons and F. E. Harris

## SUMMARY OUTLINE


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After an all-time record of 9,241,564 short tons valued at $24,131,733 in 1937 the output of salt from domestic mines, wells, and ponds dropped 13 percent to 8,025,768 tons valued at $23,242,561 in 1938. According to reports of producers 2,429,100 tons of evaporated salt (valued at $15,566,439), 1,901,861 tons of rock salt (valued at $6,252,081), and 3,694,807 tons of salt in brine (valued at $1,424,041) were sold or used in 1938.

For a number of years salt in brine has comprised roughly one-half the salt production of the country. In 1937 it aggregated one-half of the total but in 1938 only 46 percent. The million-ton drop in total output of salt in 1938 was accounted for almost entirely by the 936,773-ton decrease in the production of salt in brine. The output of evaporated salt was only 150,452 tons less than in 1937, while that of rock salt dropped only 128,571 tons.

*Salient statistics of the salt industry in the United States, 1930–34 (average) and 1935–38*

| | 1930–34 (average) | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Sold or used by producers: | | | | | |
| Manufactured (evaporated) short tons | 2,251,226 | 2,330,042 | 2,539,597 | 2,579,552 | 2,429,100 |
| In brine do | 3,333,391 | 3,837,613 | 4,279,760 | 4,631,580 | 3,694,807 |
| Rock salt do | 1,822,889 | 1,759,242 | 2,009,579 | 2,030,432 | 1,901,861 |
| Total: | | | | | |
| Short tons | 7,407,506 | 7,926,897 | 8,828,936 | 9,241,564 | 8,025,768 |
| Value [1] | $22,331,641 | $21,837,911 | $23,306,177 | $24,131,733 | $23,242,561 |
| Average per ton [1] | $3.01 | $2.75 | $2.64 | $2.61 | $2.90 |
| Imports for consumption: | | | | | |
| For curing fish short tons | 20,360 | 26,990 | 21,711 | 21,079 | 21,010 |
| Value | $34,492 | $53,623 | $44,382 | $45,106 | $47,800 |
| In bags, barrels, etc short tons | 2,620 | 1,960 | 1,388 | 802 | 654 |
| Value | $24,796 | $15,590 | $12,263 | $8,008 | $8,228 |
| In bulk short tons | 16,721 | 22,295 | 27,942 | 24,115 | 17,849 |
| Value | $37,579 | $38,558 | $56,137 | $80,248 | $45,897 |
| Total: | | | | | |
| Short tons | 39,701 | 51,245 | 51,041 | 45,996 | 39,513 |
| Value | $96,867 | $107,771 | $112,782 | $133,362 | $101,925 |
| Exports: | | | | | |
| Short tons | 88,662 | 112,213 | 76,974 | 70,111 | 67,498 |
| Value | $642,384 | $549,522 | $463,670 | $514,858 | $469,708 |
| Apparent consumption short tons | 7,358,545 | 7,865,929 | 8,803,003 | 9,217,449 | 7,997,783 |

[1] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.



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The chemical industries as a group were not affected as much as other industries by the 1932 depression, and they recovered faster. Heavy chemicals made from brine fared even better than other chemicals. Soda ash, for example, was aided by the growth in the glass industry, now the leading consumer of this material, and caustic soda shared in expansion of the rayon industry. The average monthly index of rayon deliveries rose from 74 in 1923 to 296 in 1929 and subsequently rose even more spectacularly to 816 in 1938. Meanwhile the Federal Reserve Board index for general business increased only from 102 in 1923 to 118 in 1929 and dropped to only 86 in 1938. Paper manufacture, another large consumer of soda ash and caustic soda, likewise has been much more active than other industries. For these reasons the output of salt in brine is still relatively high, even after the million-ton drop in 1938. In terms of index numbers based on percentages of the 1923–25 average output, it stood 50.5 points higher than the index of general industrial activity. The index for evaporated and rock salt, which depend on the relatively stable food industries, was 10 points higher than the general index. (See fig. 1.)

A report [1] on the marketing of salt was published early in 1939.

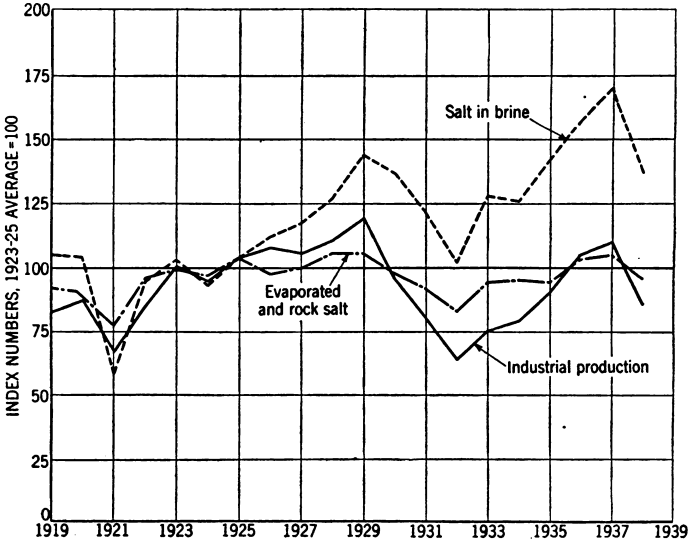


FIGURE 1.—Index of salt used in brine and evaporated and rock salt compared with Federal Reserve Board index of industrial activity, 1919–38.

## PRODUCTION

Notwithstanding a decrease in output, 79 plants (63 companies) reported operations in 1938 compared with 73 plants (59 companies) in 1937. Minerals Yearbook, 1936 (p. 920), listed producing companies in 1935, location of plants, and class of salt produced. Changes since then have been given in subsequent issues of Minerals Yearbook. Those in 1938 are as follows: Oliver Bros. Salt Co. and the American Salt Co. reopened and operated solar salt works at Mt. Eden, Alameda County, Calif.; the United States Vanadium Corporation, Uravan, Colo., produced evaporated salt for use in its own works at Bedrock,

[1] Harris, F. E., Marketing of Salt: Bureau of Mines, Inf. Circ. 7062, 1939, 56 pp.

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Montrose County, Colo.; the Arenac Salt Co. was reported to have started operations near Sterling, Saginaw County, Mich.; plants along the Virgin River in Clark County, Nev., formerly producing small quantities of salt, have been submerged by the Boulder Dam project; the Union Potash & Chemical Co., Carlsbad, Eddy County, N. Mex., produced a small quantity of rock salt in connection with its development of potash deposits; Ezra S. Blackman, Freedom, Wood County, Okla., gathered a small quantity of solar salt from salt streams—a small refinery owned by him at this place was idle in 1938; the Crane Salt Co., Crane City, Crane County, Tex., started to produce solar salt from a salt lake on a small scale in 1938; and the Crystal White Salt Co., Salt Lake City, Utah, began construction of a plant at Grantsville, Tooele County, but no salt was marketed.

On the accompanying map (fig. 2) showing salt works and commercial deposits, prepared in collaboration with H. I. Smith, Geological Survey, no attempt has been made to include idle or abandoned plants. Only those plants producing in 1938 are shown. Because of the small scale of the map, surface deposits from which the salt is merely gathered, crushed, and sold without further treatment have been given the same designations as rock-salt mines and works where the salt occurs at depth. There are several such operations in California and near Redmond, Utah.

Several recent discoveries are shown on the map. A report [2] of the Louisiana Geological Survey refers to the 68 known salt domes of that State and cites the discovery (in 1937) of salt at Rodessa in northern Louisiana as an indication that a connection may exist between the North Louisiana and East Texas salt-dome areas. The North and South Louisiana salt-dome regions also may be connected, but the 60-mile-wide strip separating them is as yet relatively unexplored and is not mapped as salt bearing. New deposits have been discovered incident to drilling for oil in counties bordering the lower Gulf Coast region of Texas. In the Paradox Valley of Utah and western Colorado thick deposits of salt have been found, indicating an extensive salt field.

The following tables contain statistics on salt sold or used by producers in the United States by States and by methods of manufacture. Because of the small number of producers of salt in brine for chemical manufacture and of rock salt and evaporated salt in certain States, it is impossible to show either rock salt or salt in brine separately by States.

*Salt sold or used by producers in the United States, 1936–38, by States*

| State | 1936 | | 1937 | | 1938 | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| California | 368,290 | $2,576,873 | 370,911 | $1,817,830 | 349,856 | $1,940,449 |
| Kansas | 704,164 | 2,580,166 | 654,089 | 2,759,062 | 597,909 | 2,565,447 |
| Louisiana | 918,414 | 2,436,971 | 974,403 | 2,898,826 | 958,186 | 2,775,384 |
| Michigan | 2,354,282 | 5,882,718 | 2,476,406 | 6,506,120 | 2,078,612 | 6,151,154 |
| New York | 2,021,983 | 5,609,932 | 2,084,867 | 5,795,551 | 1,717,064 | 5,467,077 |
| Ohio | 1,633,056 | 2,545,027 | 1,733,875 | 2,625,644 | 1,489,270 | 2,562,620 |
| Puerto Rico | 10,951 | 43,705 | 12,116 | 53,381 | 12,508 | 61,917 |
| Texas | 316,006 | 615,815 | 364,780 | 623,037 | 324,449 | 624,096 |
| Utah | 56,480 | 168,706 | 69,696 | 205,328 | 61,959 | 192,495 |
| West Virginia | 117,401 | 719,382 | 128,715 | 713,421 | 129,568 | 721,490 |
| Other States [1] | 327,909 | 126,882 | 371,706 | 133,533 | 306,387 | 180,432 |
| | 8,828,936 | 23,306,177 | 9,241,564 | 24,131,733 | 8,025,768 | 23,242,561 |

[1] 1936–37: New Mexico, Oklahoma, and Virginia; 1938: Colorado, New Mexico, Oklahoma, and Virginia.

[2] Louisiana Geological Survey, Department of Conservation, Origin of the Cap Rock of Louisiana Salt Domes: Geol. Bull. 11, August 1938, p. 19.

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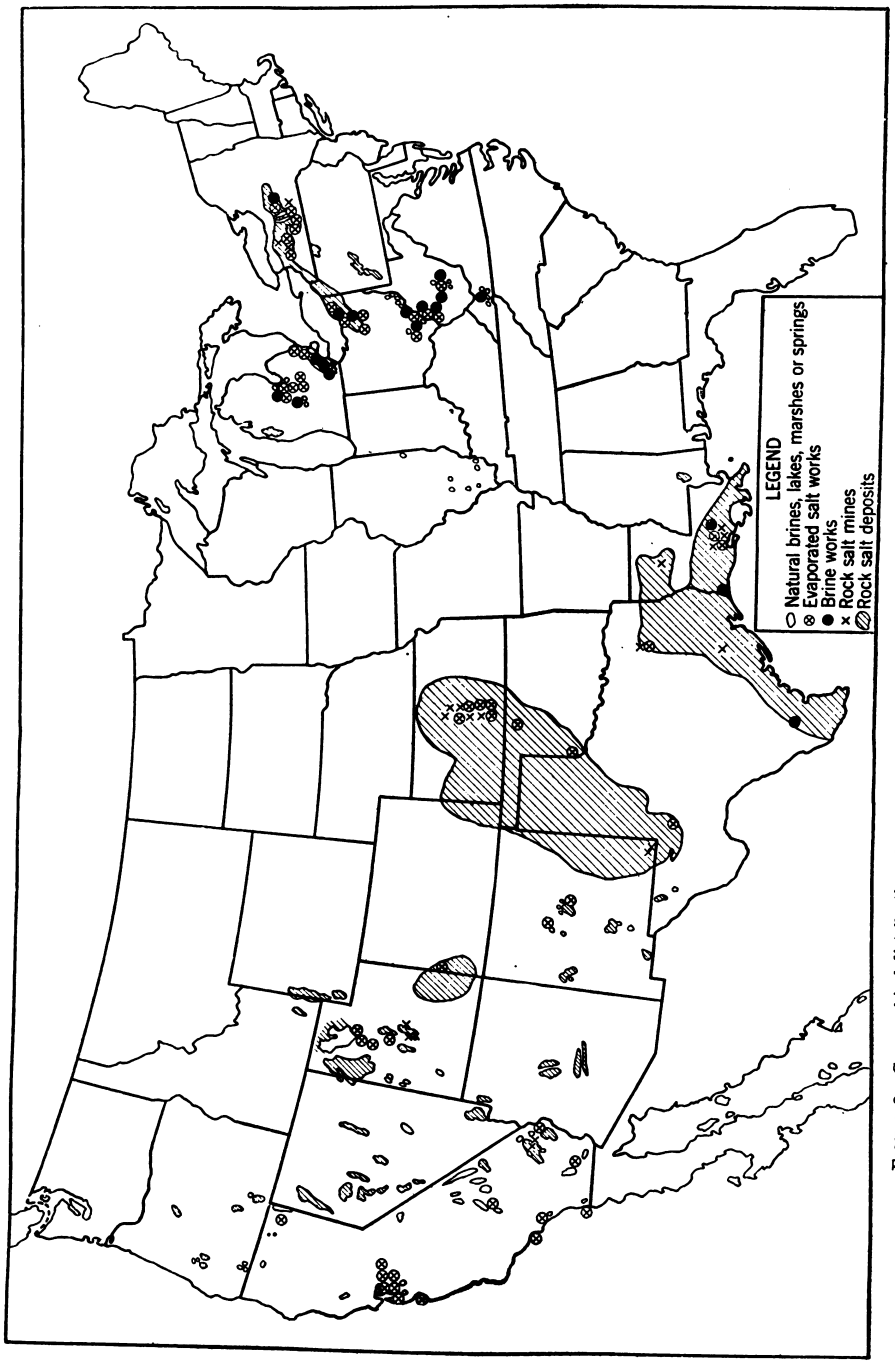


FIGURE 2.—Geographical distribution of salt-producing plants in the United States in 1938 and principal known deposits.

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*Salt sold or used by producers in the United States, 1937–38, by methods of manufacture*

| Method of manufacture | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Evaporated in open pans or grainers | 493,039 | $4,088,048 | 482,154 | $4,025,375 |
| Evaporated in vacuum pans | 1,603,825 | 9,424,260 | 1,479,806 | 9,072,224 |
| Solar evaporated | 362,627 | 1,342,153 | 330,441 | 1,352,568 |
| Pressed blocks from evaporated salt | 120,061 | 966,812 | 136,699 | 1,116,272 |
| Rock | 2,001,451 | 6,207,397 | 1,865,603 | 5,970,972 |
| Pressed blocks from rock salt | 28,981 | 240,251 | 36,258 | 281,109 |
| Salt in brine (sold or used as such) | 4,631,580 | 1,862,812 | 3,694,807 | 1,424,041 |
| | 9,241,564 | 24,131,733 | 8,025,768 | 23,242,561 |

*Evaporated salt.*—The output of evaporated salt, produced by 37 plants either from the original brine of wells and ponds or from brine obtained artificially by forcing the water into beds of rock salt and withdrawing it for processing by one of several methods in use, amounted to 2,429,100 tons valued at $15,566,439 in 1938. This includes 136,699 tons of cattle-salt blocks valued at $1,116,272 produced by 17 plants. Of the evaporated-salt plants, 22 used solar methods. Most of the salt comes from sea water in San Francisco Bay, Calif., and some from salt lakes and playas in Utah, New Mexico, Oklahoma, and Texas. Although a large quantity of solar salt is sold crude, that sold as table salt and for some industrial uses commonly is refined.

*Evaporated salt sold or used by producers in the United States, 1937–38, by States*

| State | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| California | 362,917 | $1,785,854 | 343,008 | $1,912,637 |
| Kansas | 238,179 | 1,869,150 | 217,918 | 1,724,635 |
| Michigan [1] | 896,946 | 4,735,464 | 841,836 | 4,672,529 |
| New York | 372,635 | 3,562,823 | 340,137 | 3,378,167 |
| Ohio | 395,665 | 2,323,195 | 372,711 | 2,307,949 |
| Puerto Rico | 12,116 | 53,381 | 12,508 | 61,917 |
| Texas | 38,443 | 202,482 | 38,362 | 208,533 |
| Utah | 65,902 | 191,521 | 56,597 | 173,746 |
| West Virginia [1] | 128,715 | 713,421 | 129,568 | 721,490 |
| Other States [2] | 68,034 | 374,982 | 76,455 | 404,836 |
| | 2,579,552 | 15,812,273 | 2,429,100 | 15,566,439 |

[1] Includes a quantity of salt content of brine for chemical use reported as evaporated salt with value as evaporated salt.
[2] 1937: Louisiana, New Mexico, and Oklahoma; 1938: Colorado, Louisiana, New Mexico, and Oklahoma.

*Rock salt.*—Production of rock salt reported by 21 plants aggregated 1,901,861 tons valued at $6,252,081. The total includes 36,258 tons of blocks valued at $281,109, produced by eight plants. New York again led in rock-salt production, followed by Louisiana, Kansas, and Michigan. These four States produced 92 percent of the total rock salt mined. Texas now produces considerable rock salt, and California, New Mexico, and Utah also are producers.

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*Rock salt sold by producers in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 1,913,182 | $6,306,095 | 1937 | 2,030,432 | $6,447,648 |
| 1935 | 1,759,242 | 5,510,413 | 1938 | 1,901,861 | 6,252,081 |
| 1936 | 2,009,579 | 6,003,054 | | | |

*Salt content of brine.*—The quantity of salt in brine sold or used by producers for the manufacture of chemicals in 1938 was 3,694,807 short tons, a 20-percent decrease from the 4,631,580 tons in 1937 but still 11 percent greater than the 1930–34 average, and 13 percent greater than the 1925–29 average. Salt in brine was produced at 10 plants in 1938, excluding 2 plants where the product is reported as evaporated salt rather than as salt in brine. The greater part of this salt is used by the producers in the manufacture of their own chemical products, but some is now being sold in the form of brine to other manufacturers.

*Pressed blocks.*—The output of pressed blocks from both evaporated and rock salt, reported by salt producers, was 172,957 tons valued at $1,397,381. Blocks from evaporated salt, which comprised 79 percent of all reported, were made chiefly in Kansas and Michigan, but smaller quantities were produced in California, Texas, Ohio, Utah, Louisiana, and New York. Blocks from rock salt were made chiefly in Louisiana and Kansas, with small quantities in Texas and Utah. The figures herein reported do not include pressed blocks made from salt bought in the open market. The higher unit value of blocks is due largely to the labor involved in shaping and sizing the blocks and to the inclusion of other materials beneficial to cattle.

*Pressed-salt blocks sold by original producers of the salt in the United States, 1934–38*

| Year | From evaporated salt | | From rock salt | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 139,445 | $999,170 | 29,344 | $166,269 | 168,789 | $1,165,439 |
| 1935 | 126,005 | 900,040 | 24,691 | 156,002 | 150,696 | 1,056,042 |
| 1936 | 134,586 | 965,114 | 34,489 | 222,864 | 169,075 | 1,187,978 |
| 1937 | 120,061 | 966,812 | 28,981 | 240,251 | 149,042 | 1,207,063 |
| 1938 | 136,699 | 1,116,272 | 36,258 | 281,109 | 172,957 | 1,397,381 |

## DISTRIBUTION

The following table was compiled from data furnished by the producers only, no account having been taken of reshipments. Information was supplied by all but two producers, and the necessary inclusion of their sales with shipments to "Other" States makes the figures for some States incomplete.

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*Distribution (shipments) of evaporated and rock salt in continental United States, 1937–38, by States of destination, in short tons*

| Destination | 1937 | | 1938 | |
|---|---|---|---|---|
| | Evaporated | Rock | Evaporated | Rock |
| Alabama | 6,464 | 29,726 | 6,194 | 31,532 |
| Arizona | 6,827 | 2,774 | 7,387 | 2,444 |
| Arkansas | 7,104 | 21,051 | 6,451 | 19,103 |
| California | 220,282 | 7,794 | 218,599 | 6,848 |
| Colorado | 22,367 | 13,908 | 23,910 | 11,330 |
| Connecticut | 12,794 | 4,217 | 13,234 | 4,198 |
| Delaware | 3,471 | 42,523 | 2,446 | 34,330 |
| District of Columbia | 4,909 | 1,050 | 4,742 | 1,053 |
| Florida | 5,911 | 19,073 | 5,681 | 18,271 |
| Georgia | 14,967 | 41,001 | 14,779 | 40,325 |
| Idaho | 12,134 | 728 | 10,411 | 2,966 |
| Illinois | 237,087 | 136,441 | 220,080 | 127,751 |
| Indiana | 60,730 | 53,609 | 60,197 | 36,608 |
| Iowa | 62,186 | 73,076 | 68,435 | 75,020 |
| Kansas | 40,948 | 137,605 | 37,542 | 120,527 |
| Kentucky | 29,549 | 16,151 | 32,841 | 13,153 |
| Louisiana | 5,366 | 46,185 | 5,909 | 51,564 |
| Maine | 9,646 | 20,968 | 6,855 | 16,978 |
| Maryland | 29,236 | 23,444 | 24,744 | 20,424 |
| Massachusetts | 50,635 | 27,997 | 47,667 | 30,206 |
| Michigan | 263,064 | 40,769 | 222,588 | 42,652 |
| Minnesota | 76,500 | 63,755 | 80,438 | 60,266 |
| Mississippi | 2,743 | 27,129 | 2,645 | 29,966 |
| Missouri | 56,695 | 55,698 | 56,717 | 48,943 |
| Montana | 13,656 | 2,095 | 13,378 | 1,914 |
| Nebraska | 27,817 | 42,937 | 24,263 | 40,378 |
| Nevada | 2,418 | 168 | 2,054 | 115 |
| New Hampshire | 5,492 | 29,269 | 3,552 | 26,065 |
| New Jersey | 63,077 | 106,794 | 55,075 | 101,173 |
| New Mexico | 4,897 | 12,182 | 4,513 | 10,741 |
| New York | 192,658 | 341,519 | 182,528 | 318,836 |
| North Carolina | 41,231 | 34,254 | 35,842 | 30,185 |
| North Dakota | 10,979 | 4,483 | 10,064 | 4,550 |
| Ohio | 133,180 | 65,767 | 126,483 | 50,989 |
| Oklahoma | 24,400 | 27,455 | 22,783 | 27,481 |
| Oregon | 22,104 | 387 | 21,633 | 331 |
| Pennsylvania | 107,504 | 86,142 | 105,493 | 72,205 |
| Rhode Island | 11,394 | 6,586 | 7,544 | 6,272 |
| South Carolina | 7,270 | 12,948 | 6,982 | 15,165 |
| South Dakota | 12,456 | 11,628 | 11,870 | 13,426 |
| Tennessee | 22,712 | 38,071 | 23,767 | 36,812 |
| Texas | 43,909 | 147,824 | 43,008 | 135,054 |
| Utah | 14,281 | 2,133 | 12,500 | 3,443 |
| Vermont | 5,662 | 4,286 | 4,673 | 4,915 |
| Virginia | 46,290 | 27,843 | 46,718 | 28,829 |
| Washington | 89,869 | 997 | 84,692 | 500 |
| West Virginia | 134,689 | 51,460 | 135,754 | 67,244 |
| Wisconsin | 105,143 | 22,863 | 95,801 | 21,619 |
| Wyoming | 7,653 | 3,272 | 7,358 | 2,803 |
| Other [1] | 187,196 | 40,397 | 160,280 | 34,358 |
| | 2,579,552 | 2,030,432 | 2,429,100 | 1,901,861 |

[1] Includes production of Puerto Rico (evaporated salt); exports to Australia, Canada, Central America, Cuba, Japan, Mexico, South America, and other countries; and shipments to unspecified destinations, including Alaska, Hawaii, and Puerto Rico.

*Salt shipped to noncontiguous Territories of the United States, 1937–38, in short tons*

| Territory | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| Alaska | 7,555 | $108,789 | 6,130 | $97,858 |
| American Samoa | 3 | 171 | 4 | 264 |
| Guam | 50 | 1,502 | 37 | 1,287 |
| Hawaii | 2,047 | 53,758 | 2,144 | 55,402 |
| Midway Island | (1) | 5 | 1 | 22 |
| Puerto Rico | 1,041 | 26,759 | 1,282 | 33,781 |
| Virgin Islands | 16 | 879 | 10 | 603 |
| Wake Island | 2 | 95 | 1 | 20 |
| | 10,714 | 191,958 | 9,609 | 189,237 |

[1] Less than 1 ton.

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## VALUE AND PRICES

The average unit value for all salt at the mine, as reported by producers, rose 29 cents per short ton—from $2.61 in 1937 to $2.90 in 1938. Manufactured (evaporated) salt averaged $6.41 and rock salt $3.29 in 1938, 28 and 11 cents higher than in 1937.

Quoted prices of salt delivered at New York rose at the beginning of 1938 to $13.20–$13.80 (from $11.80–$12.80 in 1937) per ton for carlots of bagged rock salt and to $15–$15.60 (from $14–$14.50) for less than carlots. Those for vacuum common fine salt rose to $15.30–$15.70 (from $14.80) for carlots and to $16.50–$17 (from $15.50) for less than carlots. At the end of May 1938, prices for salt at New York rose again and remained nominally unchanged the remainder of the year, as follows: $13.20–$13.80 per ton for bagged rock salt in carlots and $15–$15.60 per ton in less than carlots; $15.30 per ton for bagged vacuum fine salt in carlots and $16.30–$21 per ton in less than carlots.

## PROGRESS IN TECHNOLOGY AND USES

The salt reported as salt in brine is consumed almost entirely in the manufacture of chemicals by the producers and does not enter the open market. Most of the other salt used in the manufacture of chemicals is evaporated salt which is marketed and sold by producers to chemical companies. As dry salt for chemical use is readily shipped, chemical companies using it need not be situated as close to the supply as those using brine for their raw material. Although most of the chemical companies that use brine are near the base of supply, one chemical company that owns its own brine-salt plant is more than 60 miles from the brine source. The brine is brought by gravity to the chemical plant through a 60-mile line of cast-iron pipes 14 inches in diameter, which is the longest pipe line of its kind in the world.

The utilization of the caustic soda produced with chlorine from salt is becoming increasingly important to chemical manufacturers. One method devised recently, based on treating the salt with nitric acid obtained by oxidizing synthetic ammonia, yields chlorine and a fertilizer-grade nitrate of soda. The production of salt cake by treatment of rock salt with sulfuric acid also is receiving attention.

Bureau of Mines engineers recently were asked to help solve a problem in pipe-line transportation at a western oil well where the company had difficulty because of the line freezing in cold weather, and they recommended the addition of salt. The water, unlike that at most oil fields, was fresh, and when the company pumped a saturated solution of salt water (roughly 4 tons of salt to 165 barrels of water) into its 20-mile line relief came in about 8 hours.

An ingenious system [3] of drying salt is claimed to produce a saving in the cost of steam at the Diamond Crystal Salt Division of the General Foods Corporation, St. Clair, Mich. The application of flow controllers to the Alberger and the interconnected triple-effect evaporator plants is another interesting development. The excess steam from the Alberger plant is utilized for the triple vacuum-pan evaporators, and the system of control takes care of any excess or deficiency of steam to the evaporators.

[3] Diamond, H. W., and Berry, N. E., Paper presented before the Conference on Instrumentation in the Process Industries at Carnegie Institute of Technology, Pittsburgh, Pa., Mar. 2, 1939, noted in Chem. and Met. Eng., vol. 46, No. 3, March 1939, p. 142.

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One of the most interesting developments in 1938 was the manufacture of large crystals from purified molten salt. Experiments in the laboratories of Harvard University and the Massachusetts Institute of Technology on the manufacture of large single crystals of salt in cylindrical bars 2 centimeters in diameter and 30 centimeters in length have proved the practicability of such material for optical use. In 1938 the Harshaw Chemical Co., Cleveland, Ohio, undertook the manufacture of these crystals. Sometimes the single crystals, which are remarkably clear when correctly developed, weigh as much as 25 pounds. Careful maintenance of the proper temperatures during their manufacture and annealing is most important.

In 1938 interest was shown in the problem of eliminating corrosion and pitting in equipment for salt making and that exposed to salt or brine in processing industries. The practical commercial application of noncorrosive metals and alloys in salt making was described and an installation that had withstood 4 years' wear was cited in a London journal.[4]

The impurities in salt are some of the worst attackers of equipment. In most modern salt works these impurities are removed chemically from the brine before it goes to the refining pans. However, it is advisable to use the most resistant metals or alloys and thereby reduce corrosion and scaling, which are particularly serious in the vacuum-pan process of evaporation because they interfere with the transfer of heat. The use of Monel-metal wire cloth and woven-wire filtering and conveying belts also is said to be gaining. The resistance to corrosion of Monel metal is attributed to its high nickel content.

"Pink" salt is imported into the United States (20 to 25 thousand tons annually) chiefly for curing fish along the Atlantic seaboard. This salt is predominantly sea salt that is subject to the pink bacteria. The data given in a recent report [5] are of practical value to purchasers of salt for curing fish. This report states further that the California solar salt "contains over 99 percent sodium chloride, a much higher percentage than usually obtains in products from the European salines."

## FOREIGN TRADE [6]

The duty on salt was reduced under the trade agreements with the United Kingdom and Canada which were approved in November 1938 and became effective January 1, 1939. The duty on bulk salt was reduced 43 percent—from 7 cents per 100 pounds to 4 cents per 100 pounds, or a 24-percent ad valorem equivalent, under agreements with both countries. The duty on packaged salt was reduced 36 percent—from 11 cents per 100 pounds to 7 cents per 100 pounds, or a 14-percent ad valorem equivalent, under the agreement with Canada.

Total imports of dutiable salt, chiefly in bulk, are small compared with domestic production.

Imports of salt decreased 14 percent in quantity and 24 percent in value in 1938; most of the decrease was in bulk salt. Nearly one-half of the imports in 1938 were from Tunisia, which with Jamaica and Canada supplied 98 percent of the imported salt.

[4] Chemical Age, Monel Metal in the Salt Industry: Vol. 39, No. 1002, Sept. 10, 1938, p. 192. (Abstracted in Bureau of Mines, Mineral Trade Notes: Vol. 7, No. 4, Oct. 20, 1938, p. 29.)

[5] Wilson, Anna M., Production and Composition of Commercial Salt: Dept. of Natural Resources of the Newfoundland Government, Service Bull. 7, 1938, 14 pp. (Abstracted in Bureau of Mines, Mineral Trade Notes: Vol. 7, No. 2, August 1938, p. 23.)

[6] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

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Exports of salt decreased 4 percent in quantity and 9 percent in value in 1938 compared with 1937. Shipments to Japan, which decreased 75 percent in 1937, increased 21 percent in 1938; however, shipments to Canada, Mexico, Cuba, Australia, and New Zealand, the other large markets for salt, decreased.

*Salt imported for consumption in the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| North America: | | | | |
| Canada | 5,986 | $14,186 | 8,130 | $18,724 |
| West Indies: | | | | |
| British: | | | | |
| Jamaica | 24,144 | 45,407 | 12,100 | 26,991 |
| Other British | 85 | 710 | 40 | 529 |
| French | 8 | 130 | | |
| Netherland | 409 | 972 | 348 | 765 |
| Europe: | | | | |
| France | | | 2 | 32 |
| Germany | 175 | 1,479 | 15 | 612 |
| Sweden | (1) | 50 | | |
| Switzerland | | | 1 | 40 |
| U. S. S. R. | | | (1) | 803 |
| United Kingdom | 153 | 2,345 | 273 | 3,775 |
| Asia: Philippine Islands | 135 | 945 | | |
| Africa: | | | | |
| Egypt | 8,456 | 44,053 | | |
| Tunisia | 6,445 | 23,085 | 18,604 | 49,654 |
| | 45,996 | 133,362 | 39,513 | 101,925 |

[1] Less than 1 ton.

*Salt exported from the United States, 1937–38, by countries*

| Country | 1937 | | 1938 | |
|---|---|---|---|---|
| | Pounds | Value | Pounds | Value |
| North America: | | | | |
| Bermuda | 62,656 | $724 | 56,575 | $651 |
| Canada | 89,500,877 | 206,260 | 87,186,928 | 181,063 |
| Central America: | | | | |
| British Honduras | 849,752 | 5,304 | 808,971 | 4,395 |
| Guatemala | 76,233 | 585 | 227,806 | 1,785 |
| Honduras | 280,946 | 3,180 | 300,077 | 3,957 |
| Nicaragua | 427,141 | 3,597 | 620,983 | 5,155 |
| Panama [1] | 1,059,554 | 11,501 | 1,402,711 | 18,473 |
| Mexico | 7,587,564 | 54,086 | 6,743,753 | 48,193 |
| Newfoundland and Labrador | 673,478 | 1,435 | 884,098 | 1,584 |
| West Indies: | | | | |
| British | 96,433 | 1,317 | 71,117 | 1,394 |
| Cuba | 21,808,885 | 111,871 | 18,341,667 | 97,260 |
| Dominican Republic | 458,540 | 8,736 | 476,445 | 7,791 |
| Haiti | 41,227 | 723 | 29,520 | 613 |
| Netherland | 112,541 | 2,338 | 237,320 | 3,952 |
| Other North America | 39,047 | 551 | 69,394 | 606 |
| South America: | | | | |
| Argentina | 642,360 | 3,758 | 409,410 | 2,198 |
| Brazil | | | 140,780 | 599 |
| Colombia | 29,283 | 928 | 14,356 | 221 |
| Other South America | 48,566 | 403 | 26,511 | 309 |
| Europe: | | | | |
| Ireland | 5,000 | 500 | 15,890 | 1,597 |
| United Kingdom | 172,590 | 5,384 | 24,145 | 544 |
| Other Europe | 16,035 | 432 | 12,783 | 321 |
| Asia: | | | | |
| China | 18,036 | 1,039 | 10,209 | 618 |
| Hong Kong | 57,635 | 1,198 | 36,779 | 1,166 |
| Japan | 9,336,090 | 11,886 | 11,294,250 | 21,080 |
| Philippine Islands | 560,055 | 9,198 | 739,020 | 12,873 |
| Other Asia | 64,292 | 1,548 | 54,090 | 1,597 |
| Africa | 22,721 | 782 | 51,765 | 1,556 |
| Oceania: | | | | |
| British: | | | | |
| Australia | 3,517,789 | 34,574 | 2,457,689 | 22,173 |
| New Zealand | 2,282,502 | 26,641 | 1,852,600 | 21,664 |
| French | 374,538 | 4,379 | 397,455 | 4,320 |
| | 140,222,366 | 514,858 | 134,995,097 | 469,708 |

[1] Includes exports to Canal Zone: 1,373,235 pounds, valued at $17,828, in 1938; not separately classified in 1937.

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## WORLD PRODUCTION

*World production of salt, 1933–37, by countries, in metric tons*

[Compiled by M. T. Latus]

| Country [1] | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| North America: | | | | | |
| Canada | 262,546 | 293,960 | 324,975 | 355,486 | 416,360 |
| Costa Rica | 2,900 | 3,330 | 3,500 | 3,500 | 4,287 |
| Guatemala | 5,627 | 2,913 | 2,073 | 5,665 | 9,427 |
| Mexico | 90,730 | (2) | 57,746 | (2) | 101,628 |
| Nicaragua | 28 | | | | |
| Panama | 2,604 | 4,947 | 5,541 | 4,385 | 6,898 |
| United States: | | | | | |
| Rock salt | 1,619,309 | 1,735,600 | 1,595,949 | 1,823,050 | 1,841,967 |
| Other salt | 5,279,769 | 5,169,921 | 5,595,173 | 6,186,384 | 6,541,795 |
| West Indies: | | | | | |
| British: | | | | | |
| Bahamas [3] | 2,865 | 3,175 | 545 | | 5,003 |
| Leeward Islands [3] | 35 | 1,357 | | | |
| Turks and Caicos Islands [3] | 24,960 | 18,963 | 28,803 | 41,899 | 50,833 |
| Cuba | 35,000 | 20,964 | 36,921 | 34,339 | 36,287 |
| Netherland [3] | 9,401 | 6,479 | 3,781 | 2,285 | 2,337 |
| South America: | | | | | |
| Argentina [4] | 205,568 | 194,443 | 234,441 | 247,433 | 290,123 |
| Brazil | 153,045 | 280,978 | 349,521 | 494,120 | 707,465 |
| Chile | 44,649 | 31,210 | 36,453 | 47,232 | 36,697 |
| Colombia | 161,097 | 181,052 | 181,613 | 171,455 | 164,636 |
| Ecuador: | | | | | |
| Rock salt | 109 | 114 | 119 | 138 | 138 |
| Other salt | 35,428 | 28,902 | 32,039 | 16,632 | 13,800 |
| Peru | 33,622 | 34,343 | 35,397 | 36,110 | 39,010 |
| Venezuela | (2) | 28,357 | (2) | 30,361 | [5] 25,000 |
| Europe: | | | | | |
| Bulgaria: | | | | | |
| Rock salt | 6,000 | 6,138 | 5,330 | 6,768 | 9,745 |
| Other salt | 14,000 | 48,722 | 36,629 | 47,000 | 43,602 |
| Czechoslovakia | 156,565 | 147,299 | 163,843 | 172,647 | 165,898 |
| France: | | | | | |
| Rock salt and salt from springs | 1,615,890 | 1,673,280 | 1,604,660 | 1,711,060 | 1,847,179 |
| Other salt | 513,250 | 398,070 | 356,650 | 202,040 | 480,906 |
| Germany: | | | | | |
| Rock salt | 1,841,276 | 2,024,194 | 2,077,316 | 2,383,832 | 2,757,242 |
| Other salt | 426,297 | 509,316 | 561,588 | 574,491 | 569,537 |
| Austria: | | | | | |
| Rock salt | 1,075 | 864 | 1,257 | 712 | 908 |
| Other salt | 140,669 | 163,732 | 198,209 | 191,294 | 169,883 |
| Greece | 73,448 | 107,696 | 113,980 | 74,447 | 102,285 |
| Italy: | | | | | |
| Rock salt | 344,091 | 393,306 | 483,436 | 499,798 | 603,798 |
| Other salt | 709,413 | 576,742 | 671,084 | 770,333 | 952,655 |
| Malta | 1,219 | 2,235 | 2,032 | 1,930 | 1,829 |
| Netherlands: Rock salt | [6] 64,949 | 74,759 | 70,963 | 76,271 | 132,430 |
| Poland | 449,492 | 506,383 | 515,094 | 466,525 | 602,746 |
| Portugal [3] | 55,315 | 56,511 | 81,965 | 73,944 | (2) |
| Rumania: | | | | | |
| Rock salt | 281,131 | 308,723 | 308,921 | 283,389 | 321,805 |
| Other salt | | | 1,542 | 1,750 | 2,077 |
| Spain: | | | | | |
| Rock salt | 156,756 | 160,023 | (2) | (2) | (2) |
| Other salt | 772,460 | 602,308 | (2) | (2) | (2) |
| Switzerland | 80,348 | 81,596 | 79,757 | 81,177 | 91,969 |
| U. S. S. R. | [7] 2,734,000 | [7] 3,544,000 | [7] 4,349,500 | (2) | (2) |
| United Kingdom: | | | | | |
| Great Britain: | | | | | |
| Rock salt | 19,835 | 17,650 | 16,571 | 17,569 | 18,666 |
| Other salt | 2,376,766 | 2,528,634 | 2,713,377 | 2,845,242 | 3,101,511 |
| Ireland, Northern: | | | | | |
| Rock salt | 2,107 | 3,533 | 3,282 | 3,175 | 4,254 |
| Other salt | 9,412 | 10,500 | 10,199 | 12,297 | 8,818 |
| Yugoslavia | 45,115 | 41,922 | 43,549 | 45,205 | 46,323 |
| Asia: | | | | | |
| Aden | 313,074 | 361,119 | 345,119 | 361,098 | 371,027 |
| Burma | 36,363 | 37,569 | 40,729 | 32,790 | 54,677 |
| Ceylon | 8,354 | 63,449 | 41,612 | 40,382 | 38,815 |
| China [8] | 3,170,000 | 3,220,000 | [5] 3,000,000 | [5] 3,000,000 | [5] 3,000,000 |
| Chosen [6] | 138,000 | 138,000 | 138,000 | 138,000 | 138,000 |
| Cyprus [3] | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |

See footnotes at end of table.

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*World production of salt, 1933–37, by countries, in metric tons*—Continued

| Country | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Asia—Continued. | | | | | |
| India: | | | | | |
| British: | | | | | |
| Rock salt | 1,390,443 | 1,596,531 | 1,593,593 | 1,369,861 | 1,516,984 |
| Other salt | 172,895 | 182,047 | 181,214 | 175,020 | 190,103 |
| Portuguese | 126,115 | 209,219 | 160,681 | 24,047 | 26,095 |
| Indochina | 114,814 | 160,536 | 203,210 | 192,237 | 193,558 |
| Iraq [9] | 3,739 | 5,333 | 2,394 | 2,804 | 1,810 |
| Japan: | | | | | |
| Japan proper [10] | 630,837 | 676,302 | 604,442 | 518,787 | [2] |
| Taiwan | 191,935 | 191,577 | 149,375 | 189,777 | 210,471 |
| Netherland India | 98,345 | 92,370 | 102,076 | 107,449 | [11] 52,618 |
| Palestine: | | | | | |
| Rock salt | 878 | 859 | 867 | 755 | 727 |
| Other salt | 8,405 | 9,389 | 10,376 | 8,058 | 11,717 |
| Philippine Islands | 37,938 | [2] | [2] | 53,471 | 48,905 |
| Siam [3] | 84,742 | 126,565 | 138,504 | 44,505 | 132,898 |
| Syria [5] | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Turkey | 152,400 | 190,602 | 214,688 | 220,500 | 222,226 |
| U. S. S. R. | [7] | [7] | [7] | [7] | [7] |
| Africa: | | | | | |
| Algeria | 77,878 | 42,885 | 67,990 | 62,400 | 63,767 |
| Belgian Congo | 892 | 888 | 894 | 920 | 1,004 |
| Canary Islands [5] | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Egypt [3] | 136,426 | 288,470 | 257,104 | 237,570 | 276,735 |
| Eritrea | 92,497 | 96,000 | 2,380 | 62,000 | 10,000 |
| Ethiopia: Rock salt | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| French West Africa | [2] | 1,200 | 381 | 748 | 110 |
| Kenya Colony | 2,540 | 1,760 | 2,845 | [2] | [2] |
| Libya (Italian Africa): | | | | | |
| Cyrenaica [5] | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Tripolitania [5] | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |
| Mauritius [5] | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| Morocco, French | 1,582 | 1,064 | 1,194 | 814 | 11,207 |
| Nigeria [5] | 400 | 400 | 400 | 400 | 400 |
| Portuguese East Africa | [2] | 1,689 | 3,436 | 2,520 | [2] |
| Portuguese West Africa (Angola) [5] | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| Somaliland: | | | | | |
| British [3] | 2,748 | 3,212 | 2,655 | 1,509 | 950 |
| French [3] | 34,297 | 35,497 | 76,500 | 21,985 | 85,273 |
| Italian | 216,317 | [2] | [2] | [2] | [2] |
| South-West Africa: Rock salt | 3,144 | 2,800 | 5,021 | 3,822 | 4,113 |
| Sudan, Anglo-Egyptian | [2] | 24,421 | 26,534 | 27,027 | 34,553 |
| Tanganyika Territory | 7,325 | 7,418 | 6,916 | 8,574 | 8,723 |
| Tunisia | 86,511 | 86,966 | 79,689 | 129,000 | 129,708 |
| Uganda | 1,516 | 4,950 | 1,590 | 3,405 | 3,133 |
| Union of South Africa | 88,174 | 83,233 | 87,261 | 97,904 | 106,338 |
| Oceania: | | | | | |
| Australia: | | | | | |
| South Australia | 59,527 | 62,063 | 79,255 | 67,391 | 74,739 |
| Victoria [12] | 41,055 | 46,813 | 48,356 | [2] | [2] |
| Western Australia | [2] | 2,713 | [2] | 4,295 | 3,729 |

[1] In addition to the countries listed salt is produced in Bolivia, Gold Coast, Madagascar, and Southern Rhodesia, but figures of production are not available.
[2] Data not available.
[3] Exports.
[4] Railway shipments.
[5] Estimated annual production.
[6] Sales.
[7] Output of U.S.S.R. in Asia included with U.S.S.R. in Europe.
[8] Includes Manchuria.
[9] Salt issued by the Government for sale.
[10] Year ended Mar. 31 of year following that stated. The figures do not include output from salt beds which, although situated on Government beach lands, have no fixed areas.
[11] Incomplete data.
[12] Year ended June 30 of year stated.

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# MAGNESIUM COMPOUNDS, BROMINE, CALCIUM CHLORIDE, IODINE, SODIUM SULFATE, BORATES, AND MISCELLANEOUS SALINES

By PAUL M. TYLER and A. T. COONS [1]

SUMMARY OUTLINE


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The world's largest mineral deposit is the ocean, which contains per cubic mile some 128,300,000 tons of sodium chloride (common salt), 18,000,000 tons of magnesium chloride, 7,800,000 tons of magnesium sulfate, 5,900,000 tons of calcium sulfate, 4,100,000 tons of potassium sulfate, 600,000 tons of calcium carbonate, and 360,000 tons of magnesium bromide, together with a host of minor constituents. A cubic mile of sea water weighs 4,710,000,000 tons. The ocean covers 70.73 percent of the earth's surface, or 132,295,000 square miles; its average depth is 2.38 miles and its total volume 331,522,100 cubic miles.[2] In 1937 the Ethyl-Dow Chemical Co. pumped through its North Carolina plant 111,984,000 tons of ocean water to extract some thousands of tons of bromine. The unrecovered minerals, if extracted, would have been worth $136,595,370 at current prices and weighed 4,090,147 tons, according to figures made public by an affiliated corporation.[3] The elements not recovered included 0.071 ton of gold, worth $59,700; 2.22 tons of silver, $34,600; 13 tons of copper, $6,770; 195 tons of aluminum, $81,900; 206 tons of iron, $16,460; and 4.54 tons of iodine, $10,440. The intake of common salt totaled 3,005,000 tons (valued at $45,100,000), Epsom salts 764,000 tons, calcium chloride 165,700 tons, potassium chloride 85,900 tons, and strontium carbonate 226 tons, in addition to 68,900 tons of magnesium in the form of chloride.

Salts are ionized in solution, and percentage estimates as to quantities of specified compounds can be altered, owing to the various rearrangements and new chemical combinations into which the elements can be made to enter. Most of the sodium compounds of

[1] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Taylor, H. F., A Cubic Mile of Ocean: Canadian Min. Jour., vol. 52, No. 29 December 1931, pp. 852-855.
[3] Universal Engineer, Unrecovered Chemicals: Vol. 68, No. 3, September 1938.



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commerce, in fact, are recovered by processing common salt, and these manufactured compounds compete with those recovered more or less directly from sea water and natural brines.

Virtually all natural waters carry dissolved salts, and the flowage from wells or springs frequently is highly mineralized. Occasionally water is pumped down into beds of soluble salts and then brought back to the surface in the form of quasi-artificial brines. All these more or less natural brines are used as sources not only of common salt but also of other saline minerals. Great closed basins where rainfall is deficient and streams have no outlet to the ocean contain salt lakes or, more often, playas and marshy beds of dried-up lakes ranging in size from small sloughs with a scanty encrustation of salts on the surface of the mud to thick beds several miles in extent. Unique in the variety of minerals is the large deposit in Searles Lake, San Bernardino County, Calif., which, after several false starts, was first utilized in 1917 as a source of potash and subsequently has yielded as joint products borax, trona, sodium sulfate, and in 1938, lithium compounds as well. Somewhat similar operations are conducted at Owens Lake in Inyo County, Calif., which, however, yields chiefly soda ash, sodium bicarbonate, and trona. Both lakes yield borax but sodium borate produced in the form of kernite from near Mojave, Calif., and small quantities of colemanite (calcium borate) are also produced in California.

Magnesite formerly was virtually the only magnesium compound of large industrial importance, but later large quantities of dolomite were used not only for making basic carbonate for heat-insulating coverings but also for other compounds and for refractories. Then magnesium salts, separated from Michigan brines, became important, and in 1937 even dead-burned magnesite began to be synthesized in California from sea-water bitterns. Brucite, the natural hydrate of magnesia, was first mined in Nevada in 1934. The interchangeability of magnesium raw materials is illustrated further by the utilization in Europe of carnallite and kieserite, which occur in the German (Stassfurt) potash deposits. As yet the separation of magnesia from talc and other silicate combinations does not appear to be economical, but olivine (discussed in the Minor Nonmetals chapter of Minerals Yearbook) is mixed with magnesite and utilized for refractories of the "Forsterite" type.

Most important of all saline minerals is common salt, which is discussed in a separate chapter of Minerals Yearbook 1939. Potash likewise is treated in a separate chapter. Salt-works byproducts, however, including not only magnesium compounds but also calcium chloride, bromine, and iodine, are no longer included in the chapter with salt but are discussed in this chapter with magnesite and magnesium compounds, which in former years were treated separately in the Yearbook.

## MAGNESITE

Following the usual pattern of refractory-product sales (which are more sensitive than consuming industries to an oncoming recession and do not pick up again until well along in the ensuing recovery), the apparent consumption of dead-burned magnesite in the United States in 1938 was 54 percent less than it was in 1937, whereas open-hearth steel production dropped only 44 percent. Total sales of

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domestic and imported caustic calcined magnesite dropped 31 percent and those of crude magnesite, never important, 52 percent.

The Northwest Magnesite Co. (executive offices, Farmers Bank Building, Pittsburgh, Pa.) operated two or three of its six kilns (300 tons total daily capacity) at Chewelah, Wash., for 8 months of the year. Crude magnesite was mined at both the Finch and Allen-Moss properties. Some of the deposits in this area measure hundreds of feet in width and merge indefinitely into the adjoining rock mass, so that their boundaries can be determined only by sampling and chemical analysis. The magnesite is interfingered with dolomite and contains disseminated calcite, talc, serpentine, quartz, and shale. Hitherto only the best parts of the deposit have been mined and great quantities of magnesite-bearing waste have been rejected. The Bureau of Mines and the State Electrometallurgical Research Laboratories, Pullman, Wash., in cooperation have worked out processes for beneficiating this material successfully by froth flotation. Electrothermal methods resembling those employed at Radenthein, Austria, are also being perfected for manufacturing magnesium metal, using power from Grand Coulee Dam.

*Salient statistics of the magnesite industry in the United States, 1935–38*

| | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|
| Crude: | | | | |
| Mined: | | | | |
| Short tons | 177,154 | 207,119 | 203,437 | [1] 97,000 |
| Value [1] | $1,192,052 | $1,411,664 | $1,483,492 | [1] $725,000 |
| Sold by producers: | | | | |
| Short tons | 1,626 | 1,669 | 1,952 | 919 |
| Value | $22,345 | $24,420 | $29,203 | $12,332 |
| Average per ton [2] | $13.74 | $14.63 | $14.96 | $13.42 |
| Imports for consumption: | | | | |
| Short tons | 49 | 59 | 34 | 36 |
| Value | $1,084 | $1,130 | $313 | $777 |
| Apparent new supply, short tons | 1,675 | 1,728 | 1,986 | 955 |
| Percent domestic | 97.1 | 96.6 | 98.2 | 96.2 |
| Caustic calcined: | | | | |
| Sold by producers: | | | | |
| Short tons | 6,049 | 7,998 | 10,031 | 7,400 |
| Value | $170,326 | $221,410 | $311,326 | $228,498 |
| Average per ton [2] | $28.16 | $27.68 | $31.04 | $30.88 |
| Imports for consumption: | | | | |
| Short tons | 1,441 | 2,196 | 2,798 | 1,452 |
| Value | $36,076 | $49,674 | $62,420 | $39,551 |
| Apparent new supply, short tons | 7,490 | 10,194 | 12,829 | 8,852 |
| Percent domestic | 80.8 | 78.5 | 78.2 | 83.6 |
| Dead-burned: | | | | |
| Sold by producers: | | | | |
| Short tons | 72,438 | 89,979 | 83,204 | 38,738 |
| Value | $1,361,949 | $1,713,527 | $1,598,336 | $730,978 |
| Average per ton [2] | $18.80 | $19.04 | $19.21 | $18.87 |
| Imports for consumption: | | | | |
| Short tons | 24,674 | 42,608 | 56,020 | 24,990 |
| Value | $429,830 | $662,567 | $795,047 | $371,669 |
| Apparent new supply, short tons | 97,112 | 132,587 | 139,224 | 63,728 |
| Percent domestic | 74.6 | 67.9 | 59.8 | 60.8 |

[1] Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.
[2] Average receipts f. o. b. mine shipping point.

The new sea-water plant of the Westvaco Chlorine Products Corporation (executive offices, 405 Lexington Avenue, New York, N. Y.) at Newark, Calif., was operated successfully in 1938, its product being sold throughout the year to the same customers who formerly purchased material from the company mines. The product is so nearly identical to the mine product from the standpoint of performance

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that certain users may not even have realized the source of the material they received. The Tycrete Chemical Corporation (Chula Vista, Calif.) reported production of crude magnesite in Imperial County, which it converted in a small rotary kiln into caustic-calcined magnesite for building uses.

A small quantity of magnesite was produced by the Eastern Magnesia Talc Co., Inc. (206 Bank Street, Burlington, Vt.) as a byproduct of its talc-milling operations at Johnson, Vt. The material is quite high in iron oxide, and a substantial tonnage should be available in 1939.

## IMPORTS

The United States, usually a large buyer of Austrian dead-burned magnesite, reduced its imports of that material to 6,691 tons in 1938 from 24,271 tons in 1937, or 72 percent. Imports from Czechoslovakia declined 64 percent, whereas those from Manchuria (Kwantung) were less drastically curtailed. Of special interest was the relatively large importation from Japan, hitherto an insignificant source. It is believed that the 907 tons imported from Japan in 1938 came from newly exploited deposits in Chosen. Korean magnesite previously had been offered at around $10 a ton f. o. b. shipping point, and it was reported that Japanese vessels had agreed to transport it to any United States Atlantic port for $3 a metric ton, making the landed cost far below that of European magnesite.

With the announcement in August 1938 that the United States intended to negotiate a trade agreement with Venezuela, notice was given of possible reduction in the tariff protection on domestic magnesite that has been operative since 1922.

*Magnesite imported for consumption in the United States in 1938, by countries and classes*

| Country | Crude | | Caustic calcined | | | | Dead-burned and grain, and periclase | |
|---|---|---|---|---|---|---|---|---|
| | | | Lump | | Ground | | | |
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| Austria [1] | | | | | | | 3,362 | $49,000 |
| Canada | | | | | | | 6 | 563 |
| China | | | | | | | 84 | 1,003 |
| Czechoslovakia | | | | | | | 3,236 | 53,330 |
| Germany [1] | | | (2) | $171 | 1 | $56 | 3,329 | 54,860 |
| Greece | | | | | 94 | 2,765 | | |
| India, British | 9 | $70 | 359 | 6,164 | | | | |
| Japan | | | | | | | 907 | 15,143 |
| Kwantung | | | | | | | 13,249 | 179,135 |
| Netherlands | 27 | 707 | | | 611 | 18,641 | | |
| U. S. S. R. | | | | | | | 817 | 18,635 |
| United Kingdom | | | | | 19 | 1,097 | | |
| Yugoslavia | | | 258 | 7,557 | 110 | 3,100 | | |
| | 36 | 777 | 617 | 13,892 | 835 | 25,659 | 24,990 | 371,669 |

[1] Austria included with Germany beginning May 6.
[2] Less than 1 ton.

## PRICES

At the beginning of the year the Engineering and Mining Journal was quoting dead-burned magnesite at $25 a short ton f. o. b. California or Washington (State) shipping points. For other products,

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its quotations f. o. b. California were, nominally: Artificial periclase, 94 percent MgO, $65; 90 percent, $35; caustic, 95 percent MgO, white color, $40; 85 percent MgO, no color standard, $37.50 per ton. By May the quotation on dead-burned magnesite was reduced to $22 a ton, but in September the price of the California product was restored to $25. Quotations on other products remained unchanged throughout the year.

The average values realized on domestic sales, as calculated from returns from the producers to the Bureau of Mines, held up fairly well, although the slight gains made during the preceding 2 years were canceled. The figures for crude, caustic calcined, and dead-burned magnesite, respectively, were $13.42, $30.88, and $18.87 per ton in 1938 compared with $14.96, $31.04, and $19.21 in 1937.

## THE INDUSTRY IN FOREIGN COUNTRIES

*World production of magnesite, 1933–37, by countries, in metric tons* [1]

[Compiled by M. T. Latus]

| Country | 1933 | 1934 | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|
| Anglo-Egyptian Sudan | | | 256 | (2) | |
| Australia: | | | | | |
| New South Wales | 9,512 | 15,902 | 15,940 | 17,459 | 19,807 |
| Queensland | 152 | 42 | 102 | 102 | (2) |
| South Australia | 205 | 208 | 51 | 118 | 71 |
| Victoria | 6 | 26 | 335 | 219 | 143 |
| Canada [3] | 27,158 | 27,385 | 27,112 | (4) | (4) |
| China (Manchuria) | 71,376 | 72,000 | 157,000 | 206,000 | (2) |
| Chosen | (2) | 3,168 | 2,410 | 14,258 | 37,000 |
| Czechoslovakia [5] | 49,929 | 58,235 | 70,838 | 83,270 | 92,143 |
| Germany: | | | | | |
| Austria | 164,331 | 258,382 | 300,312 | 397,776 | 459,233 |
| Prussia | (2) | 11,010 | 13,818 | 15,026 | 21,091 |
| Greece | 44,719 | 70,388 | 93,563 | 116,106 | 161,676 |
| India, British | 15,450 | 15,215 | 17,257 | 15,716 | 26,586 |
| Italy | 2,187 | 1,100 | 1,251 | 3,155 | 5,392 |
| Norway | 2,007 | 2,500 | 2,526 | 3,116 | 2,096 |
| Turkey | 951 | 628 | 1,092 | 2,247 | 1,365 |
| Union of South Africa | 1,495 | 1,667 | 1,485 | 1,694 | 1,752 |
| U. S. S. R. | 380,300 | 482,000 | (2) | (2) | (2) |
| United States | 98,145 | 91,601 | 160,711 | 187,894 | 184,554 |
| Yugoslavia [6] | 14,602 | 25,086 | 30,225 | 39,008 | 41,967 |

[1] Unless otherwise stated quantities in this table represent crude magnesite mined.
[2] Data not available.
[3] Magnesitic dolomite.
[4] Data for production not available; value reported as follows: 1936, $768,742; 1937, $677,207.
[5] Exports, less imports, of crude and sintered magnesite, the sintered being reduced to crude on the basis of 2.1 tons crude to 1 ton sintered.
[6] Serbia only.

*Austria (Germany).*—The "Anschluss" with Austria makes Germany a potentially important exporter of magnesite instead of a large importer. Following this coup d'état the name of the Austro-American Magnesite Co. of Radenthein was changed to Austrian Magnesite Co. (Österreichische Magnesit A. G.), but the majority stock interest is reported to be still held in the United States. About 50 percent of the Austrian exports of magnesite in 1937 were supplied by the Veitscher Magnesitwerke. A third company, the Styrian Magnesite Industry Co., Ltd., produces mostly caustic-calcined magnesite and has not been a member of the cartel comprising the other Austrian and Czechoslovak producers.

Deliveries of Austrian magnesite to Germany doubtless were higher in 1938 than in 1937 because production was probably greater and

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exports to other countries decreased. Exports of caustic calcined magnesite in 1938 were only 3,950 metric tons and of dead-burned 42,150 tons. Virtually no raw magnesite went outside the country in 1938, but 38,497 tons of magnesite brick and plates were exported, chiefly to France, England, and Italy. The United States is normally the largest buyer of Austrian dead-burned magnesite, but in 1938 exports to the United States were only 13,900 tons compared with 23,430 tons in 1937, and those to England declined moderately to 12,400 tons compared with 13,990 tons in 1937.

*Canada.*—Magnesitic dolomite, an intimate mixture of magnesite and dolomite, occurs at Kilmar and Harrington East, Argenteuil County, Quebec. In 1937 operations that previously were wholly open-cut were extended underground, and a modern new tunnel kiln was installed at the property of the Canadian Refractories, Ltd. This kiln, the fourth of its kind in the world, is 88 feet long and attains a temperature of 3,100° F. According to a statement by the Canadian Department of Mines and Resources, the products marketed at present include caustic calcined (for making flooring compositions and tile), dead-burned or grain material, bricks and shapes (burned and unburned), and refractory cements (finely ground).

In 1938 the reported value of the products was $420,261 compared with $677,207 in 1937 and $768,742 in 1936. The drop in 1938, however, was not quite as great as these figures suggest, because the reported value includes only that of the calcined material sold plus the cost value of the calcined magnesitic dolomite used for further manufacture by the producing company. In former years the sales value of manufactured products, such as refractory bricks and other similar materials, was also included. Imports of magnesitic dolomite into the United States are shown later in the chapter in the section on dolomite.

*Chosen.*—It is reported[4] that the Korean Government has decided to permit private companies to mine magnesite at Zuisen, Kankyo Hokudo. These deposits, estimated to contain some 3 billion tons, have been closed in the past.

*France.*—According to L'Echo des Mines et de la Metallurgie (January 20, 1939, p. 23), prices and deliveries of dead-burned magnesite and magnesite brick from Austria were not affected by the union with Germany. France imports crude magnesite chiefly from Greece, and supplies were not particularly abundant at prices ranging from 31s. 6d. to 35s. a metric ton ($7.90 to $8.75) for small cargo lots. This material, which runs 45 percent MgO, is used for making metallic magnesium, magnesium chloride, and Sorel cement, and a little is used for magnesium nitrate. Quotations for caustic calcined magnesite, 85 to 90 percent MgO, ranged from £4 10s. to £6 10s. a ton ($22 to $32).

*Union of South Africa.*[5]—Magnesite has been produced continuously on a small scale in the Eastern Transvaal. The Althorpe mine is situated in the Barberton district about 10 miles east of Kaapmuiden, near the main road and railway to Lourenco Marquea, which is 100 miles away. There are other mines in the same district and near Lydenburg. The magnesite occurs in decomposed serpentines

[4] Mining Journal (London), Korean Magnesite Deposits To Be Topped: Vol. 202, No. 5376, Sept. 3, 1938, p. 83.

[5] Sinclair, W. E., Magnesite in South Africa: Min. Mag. (London), vol. 60, No. 1, January 1939, pp. 9–12.

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and is exceptionally pure, averaging more than 97 percent $MgCO_3$, 0.85 percent $CaCO_3$, 1.20 percent $SiO_2$, and 0.48 percent $Fe_2O_3$. The yield in magnesite ranges from 10 to 25 percent of the ground removed by open-cut operations but may be higher in adit mining. After hand-sorting, much of the material is calcined in vertical shaft kilns using charcoal, and the product of the kilns is hand-sorted before crushing and bagging. Hitherto almost the entire output has been consumed more or less locally for flooring compositions, the gas being compressed and bottled for soda water, but owing to the purity of the material, the extent of the deposits, and the favorable situation of the mines for overseas shipments, an important export business may develop.

*U. S. S. R.*—In response to a request from the Bureau of Mines, the American Embassy in Moscow reports that no magnesite-production statistics have appeared in Soviet publications since 1933. The principal source is the Satka mine, which yields crude magnesite averaging 46.2 percent MgO. The output is used domestically as caustic calcined magnesite and dead-burned magnesite, although some of the latter is exported as grain and a minor amount as brick. Large-scale experiments have been made with the object of utilizing magnesite in the production of metallic magnesium. The capacity of the Satka works is about 80,000 tons a year.[6] The magnesite from these deposits, which are situated in the Western Ural Mountain district, is not quite as finely crystalline as the Styrian (Austrian) magnesite and is grayish white, but otherwise it is similar. Additional large deposits have been reported near Lake Baikal, East Siberia.

## TECHNOLOGY

Under the cooperative research program at Pullman, Wash., supervised by H. A. Doerner, of the Bureau of Mines, three methods of commercially beneficiating low-grade magnesite have been developed and described.[7] Large-scale experiments may be required to determine which is most economical in practice. The first method involves selective calcination and mulling, followed by sizing. The second method is identical, except that the concentrate produced from treating low-grade ore is concentrated further by flotation. The third method requires no preliminary calcination but involves two-stage flotation. Attempts to float magnesite directly from low-grade ores gave poor results; owing to the difficulty of depressing talc, the grade of product and recovery were low. The highest-grade product for a given recovery was obtained by first floating away calcite and most of the siliceous minerals and then floating the magnesite away from the dolomite in a second step.

According to German Patent 655,793 (January 22, 1938)[8] magnesite may be floated directly from quartz, serpentine, and calcite by adding sodium oleate, water glass, and an acid metal salt, such as aluminum chloride.

[6] Lock, L., Development of the Magnesite Works in Satka during the First Five-Year Plan: Berg- und Hüttenmänn. Jahrbuch Montan. Hochschule Leoben, vol. 85, Nos. 3–4, 1937, pp. 350–361. (Ceram. Abs., vol. 17, No. 5, May 1938, p. 186.)

[7] Doerner, H. A., and Harris, D. L., Concentration of Low-Grade Magnesite Ores by Flotation: Bureau of Mines and Washington State Coll., Bull. P–1, 1938, 30 pp.

[8] Chemical Abstracts, Deutsche Xylolith-Platenfabrik: Vol. 32, No. 5, May 20, 1938, p. 3922.

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A recent British patent (M. Levi, British Patent 473,953) covers a light-weight, heat-insulating material bonded by calcined magnesite and magnesium chloride (with or without sand, sawdust, or cement) and mixed with rice husks or hulls of other seed grains which are used whole to obtain air pockets.[9]

The development of chemically bonded magnesite brick has increased the useful range of magnesite linings for rotary cement and dead-burned dolomite kilns. Normally, where burning-zone linings of 70-percent alumina brick cost approximately $40 per foot, linings of unfired magnesite brick may cost $100 per foot. Where operating conditions are most severe, however, the additional cost has been more than offset by longer life and more regular operation.[10]

## DOLOMITE

In 1938 sales of dead-burned dolomite by domestic producers dropped to 366,626 short tons valued at $3,095,355 compared with 617,706 short tons, valued at $5,217,833 in 1937, and 596,751 tons, valued at $4,887,243 in 1936. Most of the dead-burned dolomite is used for furnace bottoms, but substantial quantities of specially prepared material are sold to the glass industry under the trade name Calcimag. Single-burned dolomite or high-magnesium lime is classed in the Bureau of Mines statistics merely as "lime," although some of it is valued for its magnesium content. Increasing quantities of raw dolomite and high-magnesium limestones are used in agriculture to correct acidity and as a source of magnesium. The need for magnesium in the soil has been increasingly recognized in recent years.

Imports of dead-burned dolomite, reported separately since June 18, 1930, comprise principally impure magnesite or the so-called magnesitic dolomite dead-burned in Canada for steelworks refractories. This product, known as "Basifrit," usually contains 62 percent MgO and 21 percent CaO. By an ingenious method of calcination the usually troublesome lime content is rendered inactive, and it is claimed that this product is quite as useful for furnace bottoms as grain magnesite containing a maximum of about 4 percent CaO. In 1938 an American company, Basic Dolomite, Inc., having bought the formula and acquired a license to make a similar product, is reported to have begun its manufacture in the United States. Brucite, mined near Luning, Nev., is used as an admixture with dolomite to raise the magnesia content.

Originally the Canadian material was imported into the United States free of duty as "magnesite," but after the tariff act of 1922 levied a duty on magnesite it was reclassified and became dutiable under paragraph 214 of that act at 30 percent ad valorem. Under the first reciprocal trade agreement with Canada it was specifically described as "dead-burned basic refractory material containing 6 per centum or more of lime and consisting chiefly of magnesia and lime," and the duty was reduced on January 1, 1936, to 27½ percent ad valorem. In the second trade agreement between the United States and Canada, effective January 1, 1939, the minimum lime content was raised to 15 percent, and the duty was lowered further to 20 percent. The average lime content of all imports of magnesitic

[9] Science Abstracts, vol. 11, No. 4, April 1938, p. 113.
[10] Rochow, W. F., Modern Service Standards for Magnesite Linings in Kilns: Rock Products, vol. 41, No. 4, April 1938, pp. 82–83.

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dolomite from Canada has been well over 15 percent and the average value has ranged from $22.62 a short ton (1932) to $25.79 (1934).

*Dead-burned dolomite [1] imported for consumption in the United States, 1930–38, by countries*

| Year | Canada | | Other countries [2] | | Total | |
|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value |
| 1930 [3] | 2,858 | $74,847 | 166 | $3,071 | 3,024 | $77,918 |
| 1931 | 6,051 | 152,795 | | | 6,051 | 152,795 |
| 1932 | 5,120 | 115,808 | | | 5,120 | 115,808 |
| 1933 | 6,763 | 163,081 | | | 6,763 | 163,081 |
| 1934 | 6,473 | 166,912 | | | 6,473 | 166,912 |
| 1935 | 7,487 | 188,888 | 32 | 826 | 7,519 | 189,714 |
| 1936 [4] | 13,893 | 348,799 | 35 | 879 | 13,928 | 349,678 |
| 1937 | 9,083 | 231,084 | | | 9,083 | 231,084 |
| 1938 | 2,875 | 67,340 | | | 2,875 | 67,340 |

[1] Reported as "dead-burned basic refractory material" since 1935.
[2] 1930, Czechoslovakia; 1935–36, United Kingdom.
[3] June 18 to December 31 only.
[4] Duty lowered from 30 to 27.5 percent on January 1, 1936.

## BRUCITE

After sundry set-backs, brucite mining has just become established on a moderately extensive scale. The deposits near Luning, Nev., are of enormous extent and high purity; but transportation difficulties proved a handicap, and the material was not readily accepted as an interchangeable substitute for magnesite. Small quantities of this natural hydrate of magnesia, $Mg(OH)_2$, have been employed in petroleum refineries and for making magnesium compounds, but the important outlet at present is in the manufacture of furnace refractories, largely to increase the slag resistance of dolomite. Mining operations are conducted under lease from the United States Brucite Corporation by Basic Ores, Inc., a subsidiary of the principal consumer, Basic Dolomite, Inc. (845 Hanna Building, Cleveland, Ohio). For 1938 statistics on the production of brucite are included with those of "Other magnesium compounds." Previously they were reported only in a miscellaneous group, although the present operators who started work in October 1936 shipped substantial tonnages in that year and increased output materially in 1937. Prior to 1936 occasional carloads had been shipped for experimental purposes, but the quantity was inconsequential.

An excellent description of the Nevada deposits was published some years ago.[11] Much of the material runs less than 2 percent silica, less than 1 percent alumina, and about 0.75 percent iron oxide. Brucite occurs in conjunction with magnesite in Washington, and a small quantity has been used locally for carving into ornaments. The mineral has been noted at Hoboken, N. J., at Brewster, N. Y., and in Pennsylvania. Specimens have been found also in British Columbia, in Quebec, and in a few places in Europe, notably on certain islands off the coast of Scotland. Reported deposits in the Russian Caucasus may have commercial significance, but none are known that compare in size and purity with those in Nevada.

[11] Callaghan, Eugene, Brucite Deposits, Paradise Range, Nevada: Univ. Nevada Bull., vol. 27, No. 1, Jan. 16, 1933, 34 pp.

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In 1938, however, brucite-bearing limestones were discovered at Rutherglen, Ontario, and at Bryson, Quebec, and this material is being considered for use in refractories and for making magnesium metal. Large deposits of hydromagnesite occur near Atlin and at other localities in British Columbia. According to a recent report, these may be utilized; the material is much superior to that found in the Reinosa district, Province of Santander, Spain, which has been mined more or less extensively notwithstanding its contamination with dolomite.

## OTHER MAGNESIUM COMPOUNDS

The total quantity of magnesium compounds other than magnesite and dolomite produced from natural sources and sold or used in the United States was 70,733 short tons valued at $1,688,570 in 1938, an increase over the 64,777 tons valued at $1,578,527 reported for 1937 and the 63,841 tons worth $1,629,725 for 1936.

In 1938, as in former years, the principal items were magnesium chloride and sulfate recovered from brine wells and sea water. However, a little carbonate, oxide, and hydroxide also are recovered from these sources, and 1938 figures include for the first time the increasingly important output of brucite, which was produced commercially in Nevada as early as 1934, but the output was not included in the Bureau of Mines figures for magnesium salts until 1938. As shipments of brucite in those years were much less than in 1938 and are not very large even yet, this omission is not especially serious and may be corrected within a year or two with the consent of the producer.

Production of technical or basic carbonate of magnesium is more important even than that of the sulfate or chloride, but most of it is made from dolomite. In 1937 the Bureau of the Census reports the production of such carbonate, probably including the small quantity recovered from bitterns, as 6,505 short tons valued at $788,215 compared with 7,301 tons valued at $877,741 in 1935, the first year for which separate statistics are available. These figures, which cover seven establishments, do not include quantities (probably much larger) consumed at producing plants in making magnesia pipe coverings and other kinds of molded insulation. Total domestic productive capacity for the dry carbonate was estimated by the Tariff Commission as 13,500 tons in 1936 but subsequently has been increased. The production made for sale is used mainly in rubber goods, printing inks, paints, varnishes, pigments, and free-flowing table salt.

According to reports received by the Bureau of Mines natural magnesium chloride was recovered by the Dow Chemical Co., Midland, Mich., with various other products from its natural brines and by the Westvaco Chlorine Products Corporation from its sea-water bitterns at Chula Vista, Calif. Epsom salt (sulfate) was produced by the Dow Chemical Co. and by C. A. Kearney Co., which operates at Epso Lake, Tonasket, Wash.; the epsomite deposit at Medicine Bow, Albany County, Wyo., was not operated in 1938. Carbonate was reported by three companies: Plant Rubber & Asbestos Works at Redwood City, Calif.; Marine Chemicals Co., Ltd., at South San Francisco, Calif.; and Morton Salt Co. at Manistee, Mich. The Marine Chemicals Co., Ltd., also reported production of magnesium oxide and magnesium hydroxide (paste, powder, and milk of mag-

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nesia). As previously noted, brucite is mined at Luning, Nev., by Basic Ores, Inc.

Under the reciprocal trade agreement with the United Kingdom, effective January 1, 1939, the duty on imported precipitated magnesium carbonate, over 60 percent of which came from the United Kingdom in 1937, was reduced from 1½ cents to 1 cent a pound. Production of magnesium sulfate in Canada, all from the Kamloops district of British Columbia, declined to 470 tons valued at $9,400 in 1938 compared with 727 tons valued at $14,456 in 1937.

*Magnesium compounds imported for consumption in the United States, 1930–38*[1]

| Year | Magnesium chloride (hydrated and anhydrous) | | Magnesium sulfate (Epsom salts) | | Calcined magnesia | | Magnesium carbonate, precipitated | | Magnesium silicofluoride or fluosilicate | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value | Pounds | Value |
| 1930–34 (average) | 861, 138 | $8, 267 | 8, 357, 367 | $51, 761 | 389, 467 | $69, 426 | 581, 958 | $26, 662 | 47, 221 | $2, 654 |
| 1935 [1] | 50, 094 | 1, 095 | 3, 060, 883 | 18, 495 | 196, 264 | 36, 297 | 601, 459 | 27, 935 | 98, 037 | 6, 500 |
| 1936 [1] | 31, 876 | 584 | 4, 334, 792 | 25, 008 | 238, 039 | 39, 098 | 754, 084 | 34, 396 | (2) | (2) |
| 1937 [1] | 64, 300 | 1, 120 | 3, 905, 303 | 26, 771 | 217, 413 | 35, 643 | 1, 042, 900 | 51, 684 | (2) | (2) |
| 1938 [1] | 81, 734 | 1, 572 | 1, 598, 316 | 12, 328 | 91, 545 | 15, 947 | 940, 069 | 53, 151 | (2) | (2) |

[1] In addition to the items reported separately, 3,668,091 pounds of calcined magnesium sulfate or calcined kieserite (not fertilizer) valued at $30,291 were imported in 1935, 5,439,651 pounds valued at $44,664 in 1936, 8, 233,726 pounds valued at $71,889 in 1937, and 6,386,795 pounds valued at $66,470 in 1938. Also 11,200 pounds of "manufactures of carbonate of magnesia" valued at $489 were imported in 1935; 13,056 pounds valued at $562 in 1937; and 5,600 pounds valued at $209 in 1938; none recorded in 1936.

[2] Not reported separately but included in the "magnesium salts and compounds, n. s. p. f."—372,291 pounds valued at $29,355 in 1936; 140,110 pounds valued at $20,462 in 1937; and 95,129 pounds valued at $17,146 in 1938.

A new magnesium product, activated magnesia, is claimed to possess properties that make it suitable for use as a decolorizing, neutralizing, or absorbing agent in industrial processes. It is made by heating precipitated magnesium hydroxide until 80 to 85 percent has been converted into oxide. The typical analysis shows 70.84 percent MgO, 14.38 percent $Mg(OH)_2$, 8.78 percent $MgCO_3$, 1.36 percent $MgSO_4$, and 3.42 percent $CaCO_3$, the remainder being silica, common salt, and oxides of iron and aluminum. The absorptive power of the dry powder for coloring matter is said to be 5 to 10 times that of bentonite or fuller's earth. It also speeds up chemical processes requiring a neutralizing agent. The activity of the product depends chiefly on the temperature of calcination and proper distribution of the heat.[12]

## BROMINE

Notwithstanding the recession in most lines of business in 1938, the production of bromine in the United States, as reported by producers to the Bureau of Mines, continued to increase, as it has in every year since 1932. The 1938 output was 16,162 short tons valued at $6,610,056 compared with 13,100 tons worth $5,180,177 in 1937 and 10,305 tons valued at $4,038,438 in 1936. Not until 1923 did bromine begin to be used in the form of ethylene dibromide for making tetraethyl lead compounds for antiknock motor fuels, and as recently as 1925 the output was only 783 tons. The latest statistics, therefore,

[12] Chemical Trade Journal and Chemical Engineer, Activated Magnesia: Vol. 102, No. 2662, May 27, 1938, p. 440. (British Patent 483,096, Apr. 12, 1938.)

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reveal an increase of almost 2,000 percent in 13 years. In the last 3 years the output of bromine has virtually doubled. Domestic demand for motor fuel of all types also has increased but only from 434,810,000 barrels in 1935 to 521,657,000 in 1938, or roughly 20 percent for the 3-year period. In the late 1920's the rate of increase in gasoline demand was about 20 percent a year, but it slowed down until in 1932 there was a slight recession. Although the uptrend was resumed later, the advance in 1938 over 1937 was barely perceptible, whereas the advance in bromine requirements was 23 percent.

Deposits of many minerals are worked out eventually, but bromine is mined from the inexhaustible reservoir of the ocean. Sea water contains only 1 pound of bromine in 2,000 gallons, yet it can yield even this small quantity economically by modern processes. In recent years the bulk of the domestic supply has come from the seaside plant at Kure Beach near Wilmington, N. C. The capacity of this plant has been increased repeatedly. Future growth is forecast in the following citation from a report of the Interstate Commerce Commission:

> Commercial operation of the dibromide plant at Kure Beach was begun in 1934 * * * the volume of traffic has ranged from 147,267 gallons of alcohol and 87,000 gallons of dibromide in the year ending June 30, 1934, to 818,855 gallons of alcohol and 1,343,000 gallons of dibromide in the 1938 fiscal year. Ultimately the movement of dibromide from Kure Beach to Carney's Point, N. J., is expected to reach 22,000,000 gallons. Dibromide also moves from Kure Beach to North Baton Rouge, La.

At consuming works the bromine compound is treated further with an alloy of metallic sodium and lead to make the tetraethyl lead fluid that is added in varying proportions to many of the better grades of so-called "ordinary gasoline" as well as to the special high-test motor fuels. On January 31, 1939, the Interstate Commerce Commission authorized a reduction of railroad rates on tank cars of ethylene dibromide from Wilmington, N. C., to Carney's Point, N. J.; the new rate is 26 cents per 100 pounds as against 89 cents formerly. The return rate between the two points on ethyl alcohol used in the process was reduced from 52 to 26 cents.

Other commercial sources of bromine in the United States include brine wells in California, Michigan, Ohio, and West Virginia. Although this country is the largest producer of bromine in the world and probably exports more than it imports, bromine is recovered in several other countries from brine wells and salt-works bitterns and is an important byproduct of the extensive potash industry that has sprung up in Palestine on the shores of the Dead Sea. In an effort to expand the demand for this bromine, the Daniel Sieff Institute at Rehoboth has investigated possible new uses of bromine derivatives as insecticides. Exports of bromine from Palestine are chiefly to the United Kingdom. Inasmuch as some of the product is warehoused at Port Said, statistics from different sources are not always comparable, but it would seem that total exports declined somewhat in 1938 after reaching a peak of 533 metric tons in 1937. Bromine-recovery plants utilizing salt-works bitterns are projected on a large scale in Italy and Japan, but so far no plants using raw sea water are known to have been built outside of the United States.

The average value of the domestic output of bromine in 1938, as reported to the Bureau of Mines by producers, was 20.4 cents a pound, or a trifle more than in 1937. This is a nominal figure, as most of the

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bromine was shipped in the form of ethylene dibromide, potassium and sodium bromide, and other compounds.

The aggregate value of imports of bromine and bromine products rose to $277,527 in 1938 compared with $225,268 in 1937 and $258,337 in 1936. The main item of imports, ethylene dibromide from Germany, advanced 23 percent over the 1937 quantity and almost equaled that for 1936. Late in 1938, however, the Bureau of Customs ordered assessment of a countervailing duty on this product of 3.775 cents a pound applicable only to imports from Germany and offsetting a bounty paid by the German Government.

*Bromine and bromine in compounds sold or used by producers in the United States, 1934–38*

| Year | Pounds | Value | Year | Pounds | Value |
|---|---|---|---|---|---|
| 1934 | 15,344,290 | $3,227,425 | 1937 | 26,200,256 | $5,180,177 |
| 1935 | 16,428,533 | 3,483,239 | 1938 | 32,324,116 | 6,610,056 |
| 1936 | 20,609,025 | 4,038,438 | | | |

*Bromine and bromine compounds imported for consumption in the United States in 1938, by countries*

| Country | Ethylene dibromide | | Potassium bromide | | Other bromine compounds | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Germany | 1,210,005 | $263,459 | | | 733 | $5,110 |
| Japan | | | 42 | $30 | | |
| Switzerland | | | | | 527 | 8,611 |
| United Kingdom | | | | | 10 | 317 |
| | 1,210,005 | 263,459 | 42 | 30 | 1,270 | 14,038 |

## CALCIUM CHLORIDE

Production and sales of calcium chloride and mixed calcium-magnesium chloride obtained directly from natural brines increased slightly in 1938 over 1937 but fell short of the all-time record of 1936. Calcium chloride is also produced as a byproduct of soda ash in the Solvay process, but sales of this material are not included in the table that follows, as the calcium comes from limestone and the chlorine mostly from sodium chloride that is elsewhere reported as salt in brine.

Imports of calcium chloride for consumption in 1938 were 1,647 short tons valued at $21,174, of which 1,605 tons valued at $20,703 came from Germany. The quantity imported in 1938 is the smallest since separate statistics became available in 1922 and compares with 2,205 tons worth $24,908 in 1937 and a maximum of 9,263 tons valued at $100,223 in 1928. Exports have fluctuated during the past decade from a high of 30,736 tons worth $525,179 in 1935 to a low of 15,425 tons and $362,658 in 1929. In 1938 they were 24,118 tons valued at $396,981.

In 1938 the Federal Trade Commission filed a complaint against four leading manufacturers and their Calcium Chloride Association, alleging price fixing and more specifically that they had (1) maintained a uniform zoning system for the United States; (2) suggested retail prices to their individual dealers and distributors; (3) exchanged information with reference to their prices and annual output; and

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(4) made identical bids. It was alleged further that expenses of the association were prorated according to estimated yearly incomes, Dow Chemical Co. and Solvay Sales Corporation paying 32½ percent each and Columbia Alkali Corporation and Michigan Alkali Co., 17½ percent each, also that each of the other three companies contributes an additional $12,500 annually for right to use a manufacturing process patented by the Dow Chemical Co.

Later the Commission issued a cease and desist in respect to the four companies and closed without prejudice its case against the Solvay Process Co. (which owns the Solvay Sales Corporation) and the Calcium Chloride Association. According to its own statement, the activities of the association "consist among other things, of direction and control of advertising, publicity, research, and engineering promotion of the various uses of calcium chloride, which are principally for dust laying and stabilization in road building, ice control, curing concrete for roads, and treatment of dustless coal and brine for refrigeration."

Of these companies only the Dow Chemical Co. produces calcium chloride from natural brines. Other companies that reported production of calcium chloride or calcium-magnesium chloride to the Bureau of Mines include Great Lakes Chemical Corporation, Filer City, Mich.; Michigan Chemical Corporation, Saint Louis, Mich.; Rademaker Chemical Corporation, Eastlake, Mich.; Pomeroy Salt Corporation, Pomeroy, Ohio; J. Q. Dickinson & Co., Malden, W. Va.; Liverpool Salt Co., Hartford, W. Va.; Ohio River Salt Corporation, Mason, W. Va.; and Westvaco Chlorine Products Corporation, South Charleston, W. Va.

*Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1934–38*

| Year | Short tons | Value | Year | Short tons | Value |
|---|---|---|---|---|---|
| 1934 | 76,719 | $1,153,159 | 1937 | 101,547 | $1,295,403 |
| 1935 | 83,546 | 1,039,103 | 1938 | 103,930 | 1,218,938 |
| 1936 | 125,911 | 1,909,908 | | | |

*Calcium chloride imported for consumption in and exported from the United States, 1934–38*

| Year | Imports | | Exports | |
|---|---|---|---|---|
| | Short tons | Value | Short tons | Value |
| 1934 | 1,975 | $26,271 | 30,715 | $566,189 |
| 1935 | 2,004 | 26,987 | 30,736 | 525,179 |
| 1936 | 2,128 | 25,678 | 27,831 | 503,966 |
| 1937 | 2,205 | 24,908 | 21,732 | 415,309 |
| 1938 | 1,647 | 21,174 | 24,118 | 396,981 |

## IODINE

The iodine industry of the United States began its second decade under auspicious circumstances. Started in 1928 and threatened with early extinction by progressive reductions in the price of Chilean iodine, it managed in 1938 to increase production, continuing the recovery that began in 1937. Imports of crude iodine, all from Chile, dropped sharply to 570,532 pounds valued at $464,303 from the record quantity of 1,967,148 pounds valued at $1,784,491 in 1937. Owing

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to the importers' policy of maintaining large stocks, these figures disclose nothing as to consumption trends; fluctuations in other years have been almost as violent.

*Iodine produced in the United States, 1934–38*

| Year | Pounds | Value | Year | Pounds | Value |
|---|---|---|---|---|---|
| 1934 | 284,604 | $342,957 | 1937 | 299,286 | $242,422 |
| 1935 | 245,696 | 248,654 | 1938 | (1) | (1) |
| 1936 | 233,925 | 212,635 | | | |

[1] Bureau of Mines not at liberty to publish figures.

*Crude iodine imported for consumption in the United States, 1934–38*

| Year | Pounds | Value | Year | Pounds | Value |
|---|---|---|---|---|---|
| 1934 | 1,481,123 | $2,134,979 | 1937 | 1,967,148 | $1,784,491 |
| 1935 | 375,819 | 420,793 | 1938 | 570,532 | 464,303 |
| 1936 | 592,217 | 558,326 | | | |

Definite efforts have been made to expand demand for iodine, which is available in almost unlimited quantities in Chile as a byproduct of nitrate manufacture. Iodine has been added to salt and to municipal-water supplies as a preventive of goiter. It is an ingredient in a variety of medicines for combating various ills of man and beast, is a valuable laboratory reagent, has important uses in photography, and is employed in many other industries, but the principal prospect for largely increasing consumption is its use in animal feeding. During 1938 research workers at the University of Wisconsin reported that they had developed a permanent, simple means for stabilizing the iodine content of salt, limestone, and other mineral feed mixtures. In England the Nitrate Corporation of Chile, Ltd., announced the formation of an Iodine Education Bureau. This bureau will collect and disseminate scientific information on iodine and will collaborate with scientific institutions in experimental research to extend the knowledge of iodine, with special reference to its use in human and animal nutrition. It is not engaged directly in sales activities.

Although domestic production was begun in 1928 in Louisiana and later in California it did not become commercially important until 1930, when the General Salt Co., Long Beach, Calif., reported a substantial output; smaller quantities were produced by the Dow Chemical Co. and the Deepwater Chemical Co., Ltd. In 1932 the Jones Chemical Co., a subsidiary of the Dow Chemical Co., was producing iodine at Long Beach, Calif., and Shreveport, La.; in 1933 the name of this company was changed to Io-Dow Chemical Co., and its Louisiana operations were abandoned. The California plant of this company has operated continuously since it was started, and because of its superior processes and financial resources has become the dominant factor in the domestic industry. The only other producer in 1938 was the Deepwater Chemical Co., which resumed operations in 1936 under process patents controlled by Dow.

One of the recovery processes owned by the Dow Chemical Co. was patented recently (United States Patent 2,144,119, January 17, 1939). The iodine liberated from brine and removed therefrom by adsorption upon activated carbon or charcoal is precipitated on the anode of an electrolytic cell employing the compressed iodine-charged carbon as cathode.

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The Chilean Nitrate & Iodine Sales Corporation reported sales of 832,290 kilograms of iodine for the fiscal year ended June 30, 1938; this figure compares with reported totals of 884,965 kilograms in 1936–37, 749,335 in 1935–36, and 462,474 in 1934–35. In June 1937 a 3½-year agreement was signed with Japan regulating Japanese exports, the exact amount to be determined in advance on July 1 of each year, in accordance with average selling prices of the preceding year, but in no event to be more than 70 or less than 25 tons. Under this agreement the Japanese firms were ordered by their Government to organize an export guild. France, which has a small domestic industry on the Brittany coast, using kelp, reestablished its import quotas on crude iodine on September 1, 1938.

The price of crude iodine was pegged for a number of years at the equivalent of almost $4 a pound. It was commonly assumed that Chilean nitrate producers could have sold it profitably at 25 cents a pound, but this was unnecessary as long as almost the only competition was from seaweed iodine costing $2 or $3 a pound. Following the development of domestic production from California oil-field waters, the price was dropped until on October 10, 1936, it was down to 81 cents a pound. In 1938, however, it was revised upward to $1.02. This is the world price quotation, other currencies being referred back to American exchange.

## BORATES AND OTHER NATURAL SODIUM COMPOUNDS

Except for a sharp decline in borax shipments due partly to greatly reduced exports, recoveries of sodium compounds, other than common salt, from natural brines and saline deposits in the United States were well-maintained in 1938, faring better than the production of similar compounds from chemical plants. Sales of natural sodium sulfate increased slightly in quantity to 80,210 short tons valued at $596,812 compared with 80,053 tons valued at $599,266 in 1937. Although sales of natural sodium carbonates (chiefly soda ash but also bicarbonate and trona) declined 4 percent in quantity they increased 4 percent in value, amounting to 100,010 tons worth $1,235,328 as against 104,711 tons valued at only $1,191,485 in 1937. Production of sodium borates in 1938 totaled 219,513 tons valued at $4,570,316, a 39-percent decrease in tonnage from the 1937 figures (358,898 tons, $7,232,897). Owing to the importance of sodium borates the total for the group decreased to 399,733 tons valued at $6,402,456, or 26 percent less than the 1937 total of 543,662 tons worth $9,023,648.

*Natural sodium compounds (other than NaCl) sold or used by producers in the United States, 1934–38*

| Year | Carbonates [1] | | Sulfates [2] | | Borates [3] | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Short tons | Value | Short tons | Value | Short tons | Value | Short tons | Value |
| 1934 | 88,325 | $1,254,113 | 16,650 | $148,225 | 242,500 | $4,822,014 | 347,475 | $6,224,352 |
| 1935 | 93,230 | 1,173,003 | 38,706 | 275,943 | 272,967 | 5,381,560 | 404,903 | 6,830,506 |
| 1936 | 102,866 | 1,106,364 | 51,608 | 336,559 | 313,759 | 6,156,123 | 468,233 | 7,599,046 |
| 1937 | 104,711 | 1,191,485 | 80,053 | 599,266 | 358,898 | 7,232,897 | 543,662 | 9,023,648 |
| 1938 | 100,010 | 1,235,328 | 80,210 | 596,812 | 219,513 | 4,570,316 | 399,733 | 6,402,456 |

[1] Soda ash, bicarbonate, sesquicarbonate, and trona.
[2] Salt cake and Glauber's salt.
[3] 1934–37: Borax, kernite, and boric acid (calculated as borax), and a small quantity of colemanite; 1938: Borax, kernite, and boric acid (calculated as borax).

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The entire output of sodium carbonates came from Owens Lake and Searles Lake, Calif. The Pacific Alkali Co., at Bartlett, and the Natural Soda Products Co., at Lone Pine (Keeler), operated at Owens Lake, Inyo County. At Searles Lake, San Bernardino County, the American Potash & Chemical Corporation, Trona, and the West End Chemical Co., Westend, also produced carbonates. All these companies except the Natural Soda Products Co. produce borax, and the American Potash & Chemical Corporation also is one of the largest producers of sodium sulfate, as well as of potash and lithium compounds, all as coproducts of Searles Lake brines. A credible estimate of production of soda ash from all domestic sources, including chemical plants using common salt as raw material, indicates a 20-percent decline in 1938 compared with 1937. The Bureau of the Census reported for 1937 a production for sale of 2,323,759 tons of soda ash valued at $33,768,770 and 142,161 tons of refined sodium bicarbonate valued at $3,606,271; in addition, 713,662 tons of soda ash was consumed in the same establishments where it was made.

The slight increase in domestic sales of natural sodium sulfate is all the more remarkable in the face of a sharp curtailment in imports of this material. Reflecting slower activity at southern kraft-paper mills, the total imports of salt cake dropped to 142,429 short tons from 220,176 tons in 1937; however, owing to the enormous increase in consumption of sodium sulfate during the last decade, the 1938 total was larger than that for any year previous to 1936. The bulk of the imports still come from Germany, but receipts from Chile increased substantially to 26,079 tons in 1938 from 17,120 tons in 1937 and 687 in 1936. No data are available as to domestic production from chemical works during the year under review. In 1937, according to the Bureau of the Census, the total output of salt cake from both chemical works and natural sources was 269,177 tons, of which 241,347 tons worth $2,367,616 were for sale. Sales of anhydrous (refined) sulfate were 21,797 tons valued at $312,285; Glauber's salt, 31,934 tons, $490,660; and niter cake, 22,983 tons, $521,601.

The Ozark Chemical Co., Tulsa, Okla., produces a large quantity of sodium sulfate as salt cake from deposits at Monahans, Ward County, Tex. This material was shipped from three new localities in 1938—the Arizona Chemical Co. (subsidiary of the American Cyanamid Co., New York, N. Y.) reported production in Texas from O'Donnell, Lynn County, and from Brownfield, Terry County, and the Salt Lake Sodium Products Co. made shipments from its plant near Salt Lake City, Utah. In 1938, as in former years, small quantities of Glauber's salt were produced in Wyoming near Rawlins, Carbon County, by the Iowa Soda Products Co. of Council Bluffs, Iowa, and at Casper, Natrona County, by W. E. Pratt. Saline deposits carrying both carbonates and sulfates of soda were reported under development in Washington, but no commercial output has been made as yet.

The greater part of the production of sodium borates is from the kernite ($Na_2B_4O_7 \cdot 4H_2O$) deposits of the Pacific Coast Borax Co. near Mojave, Kern County, Calif. However, as previously noted, borax also is produced in California in conjunction with other sodium salts from Searles Lake by the American Potash & Chemical Corporation and the West End Chemical Co.; it is also recovered from Owens Lake by the Pacific Alkali Co. at Bartlett. In the latter part of 1938 the Stanford Investment Co., Los Angeles, Calif., started mining borate

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minerals on Government lands near Tonopah, Esmeralda County, Nev., but no shipments were made. Exports of borax, after rising rapidly from 87,677 short tons in 1933 to a peak of 154,052 tons in 1937, dropped in 1938 to 77,519 tons valued at $2,642,446. This represents a reduction of 76,533 tons and accounts for 55 percent of the decrease in total shipments. The apparent quantity of borax available for domestic consumption (after deducting exports) dropped 31 percent but was greater than for any year prior to 1935.

## DEEPER DRILLING AT SEARLES LAKE

Hitherto exploration of the remarkable saline deposits of Searles Lake has been confined to wells not more than 150 feet deep, and drilling has been stopped usually as soon as mud appeared in the cores or cuttings. Not long ago, however, William F. Foshag, curator of mineralogy for the Smithsonian Institution, Washington, D. C., suggested going deeper, and, with the cooperation of W. A. Gale, director of research of the American Potash & Chemical Corporation, holes were driven to the 300-foot level.

At present Searles Lake has the general appearance of a frozen waste, the dried salts forming an icelike crust so solid that an automobile can be driven over it. Only occasionally does the water level (brine) rise to the surface, but the porous salts usually are brine-soaked a foot or two below the surface, and wells 10 to 20 feet deep yield adequate flowage for pumping to the refineries. The top crust is chiefly common salt (sodium chloride) and varies in thickness, averaging perhaps 10 feet. Underlying this crust and extending to depths of 75 to 200 feet is a relatively solid mass of intermingled saline minerals that vary greatly in composition both horizontally and vertically. At greater depths, however, the proportion of bicarbonate increases, and just above the top of the clay is a thin bed of salts rich in borax which is disseminated irregularly higher up.

The latest prospect holes reveal that reefs of dry salts extend below and are interstratified with the clay. Dr. Foshag has found from his examination of the cores that at depth these reefs are almost pure bicarbonate of soda. Although common enough as a medicinal, household, and industrial chemical, this compound has never before been known to occur naturally as a mineral. At intermediate depths he has identified another mineral that likewise has been known heretofore only as an artificial chemical compound. This is a double sulfate and carbonate of soda termed "burkeite."

Although the quantity of salts in the upper layers of this deposit is more than ample to supply the needs of commercial operations for many years, the discovery of these enormous additional beds is of much scientific interest.

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# GEM STONES

By Sydney H. Ball[1]

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Retail sales of jewelry in 1938 totaled about $276,000,000, or 11.5 percent below the 1937 sales ($312,000,000) and slightly below those of 1936 ($280,000,000). Diamond rings, watches, and gold jewelry were the principal sales items. January was a fair month, February and March were poor, and May and June were better; July witnessed a slump from which a slight improvement was noted each month until the usual marked increase in December (sales in that month usually make up 25 percent of the year's sales). Although the Christmas sales of 1938 were almost as good as those of 1937, it was disappointing that no one of the later months of 1938 exceeded those of 1937 when, it will be remembered, trade was poor. The wholesalers' jewelry sales, in comparison, were 27 to 29 percent lower than those of 1937; consequently retailers' stocks at the end of 1938 were smaller than at the end of 1937. The demand for popular-price articles was better than for items in the higher price brackets, and the sales of costume jewelry were remarkably large.

*Fashions in jewels.*—Jewels continue to be worn in almost barbaric profusion, with large stones prominent. Gold, often in two colors, is even being worn in the evening and continues its gain at the expense of platinum. Silver jewelry also became popular in 1938. The motifs range from Hindu and Persian to French of the times of Louis XIV and of the late Directoire, as well as Victorian types and those of the nineties of the last century. Massive gold chains with pendant watches, crosses, or cameos, imposing necklaces and dog collars, and jeweled flowers and leaves are popular; jeweled hair ornaments and earrings, either long pendants or set close to the lobe of the ear, are imperative with the present coiffures. Tiaras are again worn, particularly in England. Much of the jewelry is flexible, permitting the stones to move with the wearer's movements. The ensemble is as much in vogue in jewels as in dress accessories. Costume jewelry ("junk" jewelry in the trade) is sold in quantity and may foster a love

[1] One of the consulting engineers, Bureau of Mines.



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for the real article. The demand for colored stones grows, such jewelry requiring the use of countless small diamonds set pavé for contrast. The finer gems—diamonds, including "fancies," ruby, emerald, and sapphire—hold the center of the stage, but topaz and aquamarine are extremely popular, and the use of turquoise, moonstone, and amethyst and a host of other colored stones is increasing. Men are wearing more jewelry, featuring particularly star sapphire and ruby, cat's-eye, and the quartz gems.

*Domestic production.*—From the peak of American gem-stone production of $534,280 in 1909 the industry dwindled until 1934, when the value of the production was only about $3,000. Since then it has increased appreciably, and in 1938 the total output was perhaps $127,000; as the production is largely by individuals or partnerships and there is no canvass, exact figures are not available. The revival of the industry is due to two factors—the desire of tourists to purchase souvenirs and the increasing use of a variety of colored stones in jewelry. The demand by jewelers for American tourmaline, kunzite, and turquoise is insistent; the sales of Navajo turquoise-silver jewelry, for example, probably exceeded those of 1937 by some 15 percent.

In the Northwest and especially in Oregon, according to correspondence with H. C. Dake, are a large number of collectors of agate and other quartz minerals, many of whom are amateur lapidaries, while others send their "finds" to professional lapidaries, some 50 in number. It is estimated that in 1938 in Oregon material valued at $210,000 was collected; in Washington, $85,000; in Idaho, $35,000; and in Wyoming (largely moss agate) $8,000—a total of $338,000. Most of these agates remain in private collections, although it is believed that about one-fourth of the amount is sold to tourists. Turquoise valued at almost $30,000 was produced in 1938, and the United States is again the most important producer of this gem. Nevada produced over 80 percent of the total, Colorado 15 percent, and Arizona a small quantity. Southeastern Montana, as usual, produced a large amount of moss agate from the Yellowstone Valley which found a ready market among tourists. Scott's Rose Quartz Co., Custer, S. Dak., produced about 1,000 pounds of rose quartz. Considerable kunzite and a little tourmaline was produced by one firm in San Diego County, Calif.

William O. Vanderburg lists 39 turquoise mines in Nevada; in part he says:

> The production of turquoise and turquoise matrix in Nevada for 1938 was approximately 8,000 pounds, varying in value from $0.50 per pound for off-color and inferior grade material to $40 per pound for the finest quality. Due to the fact that the bulk of the production is made by individuals and firms who do their own cutting and polishing it is difficult to arrive at the value of the crude turquoise. Probably an average value for the crude material would be about $3.00 per pound. After the gems are cut and polished, sorted, and graded according to quality the value increases considerably.
>
> As a result of the increased demand for turquoise a number of deposits have been discovered in Nevada within the last 2 or 3 years. One of the notable features of turquoise mining in Nevada during the year was the shift in the bulk of the production from the deposits in Nye and Esmeralda Counties, centering around Tonopah, to the recently discovered deposits in Lander County with Battle Mountain and Austin as the producing centers. The principal producers of turquoise in Nevada in 1938 were the Burnham Bros., Guy Grannis, W. F. Godber (Western Gem & Jewel Co., Los Angeles), and Geo. McGinnis and associates, all of whom operated properties near Hickerson Summit, Lander County;

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Lee F. Hand and C. T. Johnson, owners of turquoise properties in the Royston and Crow Springs districts, Nye and Esmeralda Counties; Ed. C. Smith, who operated the Smith mine, Cortez district, Lander County; D. J. Wilson (American Gem Co., Los Angeles), who worked a deposit in Copper Basin, northern Lander County, under a lease agreement with the Copper Canyon Mining Co.; and W. F. Godber, owner of the Reik mine in the Candelaria district, Mineral County.

The turquoise mined in Nevada varies considerably in color, ranging from green, blue-green, and various shades of blue to nearly white. The best quality is a rich blue color. Off-color material is hard to dispose of in the United States, although small lots of the inferior grades of turquoise have in recent years been sold to Germany. Turquoise matrix has an established popularity with the tourist trade, and some of its numerous varieties are characteristic of certain properties such as "black", "spider web", "gold", "brown", or "pinto matrix".

The turquoise mines in Nevada are not operated continuously; activity is restricted to the summer months, and the degree of activity is dependent on the demands of the jewelry trade. One of the most pronounced trends in Nevada turquoise mining in recent years is the tendency of the cutting establishments to acquire their own mines. Only a few years ago the principal outlets for crude turquoise were traders who made annual trips through the State, bartering articles of Indian craftsmanship for the crude turquoise, and in turn trading it to the Indians of the southwest.

The mining of turquoise is popular with miners of limited means because a minimum of equipment is necessary.

The discovery of emerald at Rye Patch, Pershing County, Nev., was widely heralded early in 1939 as the first deposit of emerald found in the United States, although deposits of the gem have long been known in North Carolina and other Eastern States. The Nevada emerald occurs as unusually deep-color marginal parts of beryl crystals in a pegmatite that intrudes limestone. The deep-color material makes up a relatively small part of the beryl, and most of it is flawed and not transparent; in consequence, the commercial importance of the find is doubtful. An abandoned emerald mine 15 miles south of Spruce Pine, N. C., was reopened early in 1938. North Carolina produced a little emerald matrix.

Near Hot Springs, Ark., there are at least seven producers of rock crystal, and these and others sell the product.

Among the other gem stones produced in the United States in 1938 were agatized wood (private lands surrounding Petrified National Monument, Ariz.); amazon stone (Teller County, Colo.); amethyst (North Carolina; and Larimer County, Colo.); aquamarine (North Carolina and Chaffee and Park Counties, Colo.); chrysoberyl (Jefferson County, Colo.); garnet (North Carolina; Custer, Chaffee, and Jefferson Counties, Colo.; and Emerald Creek, Idaho); fire opal (Owyhee County, Idaho); phenacite (Chaffee County, Colo.); ruby (North Carolina and Georgia); smoky quartz (North Carolina); and topaz (El Dorado County, Calif.; Thomas Range, Utah; and Teller and Park Counties, Colo.).

Charles H. Carpp and J. W. Kaiser operated the property of the American Gem Mining Syndicate, near Phillipsburg, Mont., in 1938. They produced 9,480 ounces of industrial sapphire valued at about $11,000. The Rocky Mountain Alabaster Co., Fort Collins, Colo., quarried about 50 tons of alabaster in 1938. Some Iceland spar of optical grade was produced in California.

*Imports.*—According to the Bureau of Foreign and Domestic Commerce, imports of precious and imitation stones (exclusive of industrial diamonds) into the United States in 1938 totaled $28,304,956, a

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decrease of 36 percent from 1937. Details are shown in the following table.

| | Carats | Value |
|---|---|---|
| Diamonds: | | |
| Rough, uncut, duty free | 91, 515 | $7, 077, 159 |
| Cut, but not set, dutiable | 330, 925 | 17, 016, 842 |
| Pearls, not strung or set, dutiable | | 470, 304 |
| Other precious stones: | | |
| Rough, uncut, free | | 116, 924 |
| Cut, but not set, dutiable | | 1, 698, 916 |
| Imitation, except opaque, dutiable | | 1, 762, 458 |
| Imitation, opaque, including imitation pearls, dutiable | | 18, 896 |
| Marcasites, dutiable | | 143, 457 |

*Tariffs.*—There were few important changes in tariffs during the year. In the United States, under the provisions of the Czechoslovak Trade Agreement negotiated last spring, the duties on Czechoslovak imitation stones in the various brackets were reduced as much as 50 percent. Czechoslovakia was by far the chief source of such imitation stones, particularly rhinestones. The effect of the agreement was nullified when Germany occupied Czechoslovakia. Germany made barter agreements with some of the diamond-producing countries, without impressive results, however. A trade agreement with Brazil was canceled, and some of the others are stated to be inoperative.

*Trade terms and judicial proceedings.*—The Federal Trade Commission on March 18, 1938, issued its Trade Practice Rules for the Wholesale Jewelry Industry, a recodification of unfair methods of competition and other illegal practices in the trade. The use of the word "perfect" in describing a gem that under a 10-power loupe shows any imperfection is unfair practice; "perfectly cut" is not to be used to deceive the purchaser; the use of "diamond," "ruby," or other names is to be confined to these mineral species alone; "real," "genuine," and "natural" cannot be applied to synthetic or imitation stones; "blue white" cannot be applied to a diamond if at all off-color; articles must be as advertised; the adjective "synthetic" must be confined to synthetic stones. The Federal Trade Commission during the year issued a number of cease and desist orders against firms not living up to its trade rules.

In the fall, the Department of Commerce released texts of two commercial standards, covering gold and platinum.

The Jewelers Vigilance Committee continued its good work against shortcomings of the less ethical members of the trade; as for example, against a store that sold 0.72-carat diamonds as 1-carat solitaires. But even they are unable to do away wholly with the occasional switching of pieces of glass for diamonds, a case of this kind having occurred in Baltimore a few months ago.

*Exhibits.*—At the New York World's Fair jewels will be among the most attractive exhibits. In the House of Jewels, five of the leading New York jewlers will show their most beautiful jewelry, and De Beers & Associated Producing Cos. and the Diamond Corporation will exhibit rough and cut diamonds, an exhibit valued at over $5,000,000. In the Belgian pavilion, besides cut diamonds worth several millions, the art of diamond cutting will be shown. In Iraq's exhibit, goldsmiths from Baghdad will ply their ancient art. The Crown of the Andes, set with innumerable Colombian emeralds, is to be on exhibition. Boart Products, Ltd., is to have in the Hall of Mining and Metallurgy

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an instructive exhibit showing the industrial uses of diamonds. These exhibits should strengthen the gem consciousness of the American people and promote jewelry sales.

## DIAMOND

The improvement in the diamond industry, which had continued for over 5 years, ended in September 1937; and 1938—with its wars, changes in the political map of Europe, and financial depression—was a poor year, as was to be expected with an industry that feeds on prosperity. The small demand and a large mine output increased stocks of rough diamonds for the first time in 6 years, although stocks of cut stones in the hands of cutters and retailers are not large. Prices of rough were firm, and those of cut diamonds tended to advance.

*Share dealings.*—The shares of diamond-mining companies listed on the London Stock Exchange had a relatively narrow market in 1938. Off to a good start, by January 15 quotations began to slip, and, except for a short rally in April, the decline continued until mid-July, after which prices strengthened for 2 months. The Czechoslovak crisis affected the market adversely, but this was followed by a sharp rise in October. For the rest of the year the market was inclined to be weak. The loss for the year was about 25 percent, the quotations of five representative stocks at the year end being 37 percent of their high (1927) and 370 percent of their low (1932). Of the more important stocks, 12 paid dividends.

*Market.*—The Diamond Trading Co. sold rough diamonds valued at about £4,000,000, only 44 percent of the sales of 1937. Sales in the third quarter were quite satisfactory, those of the first and fourth quarters fair, and those of the second quarter small. Good-quality large stones are still scarce.

Sales of polished stones were only about one-half those of 1937, the principal demand being for small goods and most of them of mediocre quality. June and July were the best months, as the Czechoslovak crisis interfered with the usual purchases for the Christmas trade. The United States, Argentina, India, and (early in the year) southeastern Europe were large purchasers.

As is usual in years of political crises, investment buying increased the sale of large stones, while the mode for pavé jewelry promoted the demand for small stones. Sales of industrial stones were large.

*Growth of diamond-cutting industry.*—Diamond cutting originated in India, where diamonds first were discovered, certainly well over a thousand years ago, and to Hindu lapidaries we owe the two basic principles of the art—the wheel and the use of diamond dust. Indeed, it was not until early in the seventeenth century that Europe wrested the cutting supremacy from India and its ally, Borneo, now for the past 2 centuries the most important of the eastern cutting countries. The Hindu cut too crudely for European taste, in part prompting the growth of the European industry. By the sixteenth century European artisans surpassed their eastern confreres in skill and were in demand at eastern courts.

The art was transmitted from India to Constantinople and later to Venice. Cut stones appeared in Europe between the eighth and thirteenth centuries. The art reached northern Europe at the turn of the fourteenth century, first at Nuremberg and Paris, and probably

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Bruges only slightly later. Religious persecution drove the cutters from Bruges to Antwerp and soon thereafter to Amsterdam, later the asylum of persecuted Jews from Portugal, Spain, and Poland. Excluded from the guilds, they sought the free professions, among them diamond cutting. Diamond cutting appeared on the Western Continent in Brazil in 1802, and in the late sixties of the last century a cutting industry sprang up in the United States, small in roster but renowned for its superior product. The Government-subsidized South African industry, started in 1928, thrived for only 5 or 6 years.

The art of cutting has made steady improvement, slow at first but thereafter marked, particularly in our generation. Hindus, Venetians,

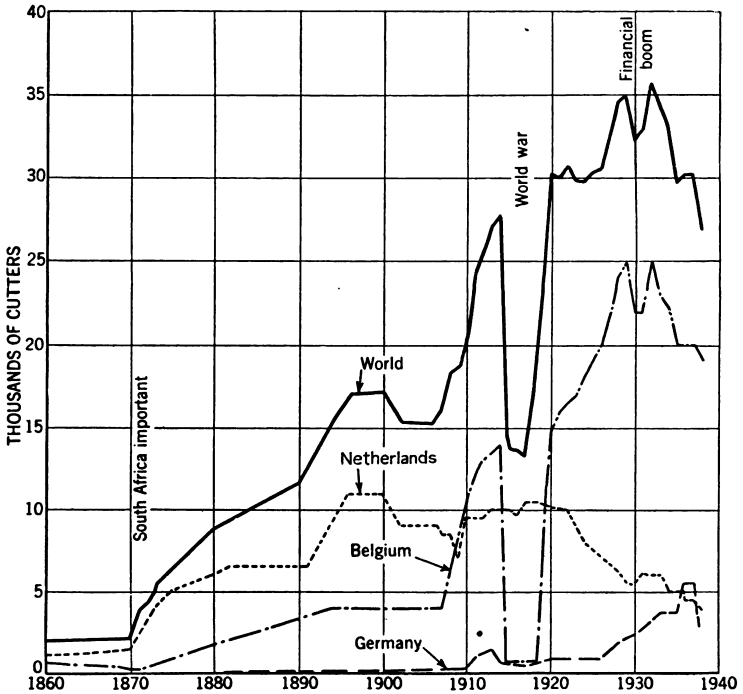


FIGURE 1.—Approximate number of diamond cutters in Belgium, Germany, Netherlands, and the world, 1860–1938.

Flemish people, both Catholic and Protestant, Netherlanders, Jews, and Americans have all made notable contributions to the craft.

An adequate supply of rough diamonds is necessary to the growth of the art. The Indian mines created the ancient industry of India and with their decline the industry died. Cutting in Borneo was fed first from the local mines, but now is supplemented by imported South African rough. Lisbon was an important cutting center while Portugal controlled the India trade, and the dominant position of the Netherlands as a cutting center was due first to her Indian trade and later to her monopoly of Brazilian rough. On the other hand, the French industry established by Cardinal Mazarin about 1650 starved to death owing to the lack of an adequate supply of rough diamonds. With the rough market centered in London, rough is now available to all cutters.

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Bruges was the dominant center during most of the fifteenth century, Antwerp from 1483 to 1585, and then Amsterdam for over 3 centuries. In 1909 Antwerp regained the lead and has held it since, except for the World War period. During the past decade the growth of the craft in Germany has been phenomenal. That country, like Belgium, cuts small rough, while the Netherlands specializes in large.

During the financial boom of a decade ago, the industry became geared to prosperous times and since 1929 has been markedly overstaffed.

An ancient industry, the secrets of which were carefully guarded till 60 years ago; once a home industry, taught by father to son, it is now carried on in large factories. Started as a family trade, it has become big business. Sixty-five years ago the prince of artisans, the diamond cutter today, due to the unjustified growth of his craft, receives an indifferent and desultory wage. Unless great prosperity awaits in the near future, many a diamond cutter must seek employment in more profitable industries.

In 1500 A. D. there were some 600 cutters (India, 500; Europe, 100): 1660, 1,400 (India-Borneo, 400; Europe, 1,000): 1700, 950 (India-Borneo, 350; Europe, 600): 1770, 1,400 (India-Borneo, 300; Europe, 1,100); and in 1810 but 700, owing to the Napoleonic wars (India-Borneo, 300; Europe, 400). The growth of the industry since 1860 is shown in figure 1.

*Cutting in 1938.*—The diamond-cutting industry had a poor year, marked by little profit for the "masters" and increased unemployment among the men. Many of the latter were absorbed by other industries. Although the Belgian and Netherland centers lost ground, the German industry, which during the past decade has had such a phenomenal growth, suffered most severely.

*Imports.*—Diamond imports into the United States in 1938, by countries, were as follows:

*Diamonds imported into the United States in 1938, by countries* [1]

[Exclusive of industrial diamonds]

| Country | Rough, or uncut | | | Cut, but not set | | |
|---|---|---|---|---|---|---|
| | Carats | Value | | Carats | Value | |
| | | Total | Per carat | | Total | Per carat |
| Austria [2] | | | | 11 | $589 | $53.55 |
| Belgium | 419 | $23,311 | $55.63 | 278,144 | 13,869,072 | 49.86 |
| Egypt | | | | 1 | 135 | 135.00 |
| France | | | | 767 | 67,608 | 88.15 |
| India, British | | | | 87 | 20,456 | 235.13 |
| Mexico | | | | 11 | 1,346 | 122.36 |
| Netherlands | | | | 50,376 | 2,902,155 | 57.61 |
| Switzerland | | | | 232 | 15,904 | 68.55 |
| Trinidad and Tobago | | | | 8 | 439 | 54.88 |
| Union of South Africa | 91,096 | 7,053,848 | 77.43 | 591 | 65,990 | 111.66 |
| U. S. S. R. | | | | 32 | 5,106 | 159.56 |
| United Kingdom | | | | 665 | 68,042 | 102.32 |
| | 91,515 | 7,077,159 | 77.33 | 330,925 | 17,016,842 | 51.42 |

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce.
[2] Figures cover period January 1 to May 5.

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*World production.*—World production of diamonds (gem and industrial) in 1938 approximated 11,755,200 carats (2.351 tons) worth about $43,000,000. Compared with 1937 this is an increase of 22.5 percent by weight, without much variation in value, as the increase was largely in low-price industrials. As only Dutoitspan and Bulfontein of the South African pipe mines were operated, the alluvial mines produced 91.5 percent by weight and 70 percent of the value. The British Empire produced 31 percent by weight and 69 percent of the value. Of the total production, less than one-fourth by weight were gem stones.

The following table gives, as accurately as available statistics permit, world diamond production for the past 5 years:

*World production of diamonds, 1934–38, by countries, in carats*

[Including industrial diamonds]

| Country | 1934 | 1935 | 1936 | 1937 | 1938 |
|---|---|---|---|---|---|
| Africa: | | | | | |
| Angola | 452,963 | 481,615 | 577,531 | 626,424 | [1] 651,000 |
| Belgian Congo | 3,331,360 | 3,812,023 | 4,634,266 | 4,925,228 | [1] 7,205,300 |
| French Equatorial Africa | | 138 | 1,550 | 6,197 | [1] 23,000 |
| French West Africa | | | 5,500 | 52,933 | 59,548 |
| Gold Coast | 2,391,609 | 1,349,847 | 1,414,677 | 1,577,661 | [1] 1,315,000 |
| Sierra Leone | 68,633 | 295,483 | 616,200 | 913,401 | [1] 900,000 |
| South West Africa | 4,126 | 128,464 | 184,917 | 196,803 | [1] 140,000 |
| Tanganyika | 1,155 | 1,446 | 2,704 | 3,234 | [2] 3,590 |
| Union of South Africa: | | | | | |
| Mines | 9,414 | 274,317 | 339,719 | 820,284 | 979,460 |
| Alluvial | 430,899 | 402,405 | 284,204 | 207,359 | 259,145 |
| Total Union of South Africa | 440,313 | 676,722 | 623,923 | [3] 1,030,434 | 1,238,605 |
| Brazil | [1] 42,500 | 39,100 | 136,462 | 238,606 | [1] 150,000 |
| British Guiana | 44,821 | 47,785 | 41,067 | 35,958 | [1] 35,000 |
| Other countries [4] | 4,000 | 5,500 | 6,000 | 6,000 | 34,200 |
| | 6,781,500 | 6,838,100 | 8,244,800 | 9,612,900 | 11,755,200 |

[1] Estimated.
[2] Exports.
[3] Includes a small quantity of diamonds recovered from retreatment of tailings.
[4] 1934: Netherland India (Borneo), India, Australia (New South Wales), Rhodesia, Nigeria, United States (California), and Venezuela; 1935: Netherland India (Borneo), India, Nigeria, and Venezuela; 1936: Netherland India (Borneo), India, Rhodesia, United States (California), and Venezuela; 1937: Netherland India (Borneo), India, Australia (New South Wales), Liberia, Venezuela, and Rhodesia; 1938: U. S. S. R., India, Borneo, New South Wales, Venezuela.

The increased production in 1938 compared to that of 1937 was due largely to an unusually large production of industrial stones by the Belgian Congo. South Africa increased its production about 20 percent, and the small outputs of French Africa and of miscellaneous sources increased markedly. The production of South-West Africa decreased about 26 percent and that of Gold Coast 17 percent.

*Industrial diamonds.*—More diamonds were used industrially in 1938 than ever before, although, as the proportion of crushing bort used increased, the dollar sales value probably was somewhat less than in 1937. The increase was due largely to the world-wide armament race and the need of a superabrasive to cut and shape hard alloy steels, as well as to the diversified use of diamond grains bonded in plastics and powdered metals. Over two-thirds, by weight, of the world diamond output is used in industry, mainly in the United States, Great Britain, Canada, Germany, and the U. S. S. R.

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The demand for industrial stones was strong throughout 1938. As the finer stones are scarce, industry was forced to use the smaller stones and those of mediocre quality more and more. Carbonado (the Brazilian "black diamond") is now selling at a price that for certain purposes renders its use attractive. Prices were firm, with an upward tendency.

Imports of industrial diamonds into the United States during the past 5 years were as follows:

*Industrial diamonds (glaziers', engravers', and miners') imported into the United States, 1934–38* [1]

| Year | Carats | Value | | Year | Carats | Value | |
|---|---|---|---|---|---|---|---|
| | | Total | Per carat | | | Total | Per carat |
| 1934 | 526,007 | $2,852,349 | $5.44 | 1937 | 1,885,970 | $6,542,365 | $3.47 |
| 1935 | 954,589 | 4,293,611 | 4.50 | 1938 | 1,396,247 | 4,213,412 | 3.02 |
| 1936 | 1,166,094 | 4,328,603 | 3.71 | | | | |

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce.

## EMERALD, RUBY, AND SAPPHIRE

For the third successive year the lavish use of colored stones in jewelry depleted the store obtainable from old jewelry and brought nearer the time when the colored-gem mines will have to increase their scale of operation or a shortage will result. Barring a world war or a financial cataclysm prices must rise.

The Government-owned Muzo emerald mine, Colombia, was closed at least most of the year and early in 1939 was to be leased to private parties. The Government gives, rather naively, the theft of the better stones by the miners as the reason for the proposed change in management. The Chivor Emerald Mines, Colombia, operated on a restricted scale in 1938. The Bank of the Republic is said to have 24,000 carats of uncut emeralds stored in its vaults. The Cobra Emerald Mine, South Africa, in 1937 was operated by the African & European Investment Co. at a small profit. The official figures of the value of emerald produced in South Africa were £6,082 in 1936 and £10,838 in 1937. Victor Leinz and O. H. Leonardos report the occurrence of emeralds in detrital deposits in the State of Goyaz, Brazil, 20 miles southeast of the city of Goyaz. The stones are of good color but are badly flawed and lack transparency. The geological occurrence suggests affiliation with occurrences in the U. S. S. R., Egypt, and North Carolina—mica schists cut by pegmatites. The emerald mine at Habachtal (former Austria) is now in German territory.

In 1937 Burma produced 157,308 carats of rubies valued at £6,841 (20 cents a carat). Its rubies and byproduct sapphires were valued at £7,069 as opposed to £7,319 in 1936. Burmese miners in Cambodia produced a few rubies, sapphires, and zircons at the alluvial mines at Païlin and at Bo-Keo. The 1936 value was 1,880 piasters, three-fourths from the first locality and one-fourth from the second. Production, in carats, has been as follows: 1934, 450; 1935, 312; and 1936, 104.

India in 1937 produced 22,736 carats of sapphire, largely from Kashmir. The value as officially given is £1,682 in 1936 and £41 in

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1937. The larger part of the Kashmir production is understood to be only usable industrially.

Sapphires valued at £1,410 were sold in the Anakie (Queensland) field in 1937 (£2,030 in 1936). Twenty-five men were engaged in mining, largely around Ruby and Sapphire, although some of them were attempting to locate new leads in the surrounding country. First blues, only a small percentage of the production, were in demand, but yellows and greens were difficult to sell. The Miners' Association sold largely in France, although a few fine stones were disposed of in America. Queensland produced gems, largely sapphires, from 1860 to 1937, inclusive, worth £643,156, the years of important production being 1907 to 1925.

The special committee appointed by the Government of Ceylon to investigate the gem-mining industry at first decided to establish a Government cutting works and a sales room at Colombo but finally recommended that the miners bring their stones to small depots where they could obtain the best current prices. The committee recommended further that an up-to-date map of the gemmiferous area be made, as it believes much illicit mining is being carried on and that there are several unexplored areas in Ceylon where gems may be found. Whether the central depots will be advantageous to the trade, time alone can tell. The Government could perhaps spend its efforts more advantageously in preventing unscrupulous merchants from selling synthetics and imitations as genuine stones.

## LESSER GEMS

The all-time opal production of New South Wales is valued at £1,622,795, although for the 10 years, 1928–37, the average yearly production has been but £4,803. The 1936 production was valued at £6,110 and that of 1937 at £3,357. In the latter year over 97 percent came from Lightning Ridge, Grawin and White Cliffs supplying the remainder. The total opal production of Queensland from 1860 to 1937 is valued at £187,745, the big production being in the last 8 years of the nineties. In 1936 the production was only worth £150 and in 1937 had shrunk to £16. This came from Sheep Station Creek in the Quilpie district, where four men prospected part of the year. South Australia had sold opal to the value of £160,158 from 1916 to 1937. In 1937, £11,887 worth of opal was marketed, the most satisfactory year since 1920. The demand was better than usual, and hence mining was more active. Coober Pedy was the principal source; but two smaller fields, Mintabic and Andamooka, also produced. Opal artifacts and jade and crystal beads were found in a cave near Nakuru, Kenya, by Dr. L. S. B. Leakey, the distinguished archaeologist. The objects are believed to date from about 4,000 B. C. Dr. Leakey believes there were important opal mines in the vicinity.

In 1937 about 40 men gophered turquoise stringers at Nishapur, Iran. The owners, an Iranian mining company in Meshed, plan to drive a large tunnel 200 to 300 feet beneath the deepest old workings, which in turn are several hundred feet beneath the surface. The company cuts and mounts the turquoise in a small shop at Meshed. The same company also mines and sells salt; according to a letter from Lester S. Thompson, to increase the sale of the latter, a cheap

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turquoise ring is concealed in every five-hundredth 1-kilo package of table salt sold. A little turquoise (20 oz. worth £8 in 1936, none in 1937) is produced from time to time in the Brisbane district, Queensland.

The Afghanistan lapis lazuli contact-metamorphic deposits are worked by long tunnels whose sides are badly smoked, the rock having been broken by fire setting. It is believed there has been no mining for 10 years, the lapis lazuli sold coming from stocks on hand. Ernest F. Fox states that the best goes to Kabul, where it is cut.

In 1937, 2,952 cwt. of jadeite were produced in Burma, nearly double the previous year's production, although the value (£13,030) was lower (£13,412).

Burma also produced amber valued at £668 (£409 in 1936). Recent production of amber in Germany was, 1935, 112 metric tons; 1936, 332 metric tons; and 1937, 328 metric tons.

Vesuvianite of fine gem quality is produced to a limited extent at Laurel, Quebec.

Considerable amounts of jet are produced in the Province of Kompong-Thom, Cambodia (1934, 13,000 kilos; 1935, 24,000 kilos; and 1936, 24,270 kilos).

The United States annually imports from Brazil 5 to 6 tons of unusually fine quartz crystals absolutely essential in radios and in telephonic, telegraphic, and optical apparatus. Even if the finest crystals are used, the finished plates represent but a twentieth of the original. Minas Geraes exports its rock crystal to the United States, Germany, and Japan. Mining is primitive and rarely is carried to any considerable depth. Recently a fine rock crystal from Minas Geraes, Brazil, was sent to this country. It weighed 63 pounds and was sold for over $1,100, or about $18 per pound.

Amethysts occur in seams in trap rock near Scott's Bay, Nova Scotia, on the Bay of Fundy. The winter's frost each year forms new outcrops. Some of the amethysts are cut in Europe, returned to Nova Scotia, set in lockets or rings, and, together with rough crystals, sold to tourists. The trade has increased greatly in the last 6 or 7 years.

Several tons of rose quartz from pegmatic dikes in Minas Geraes, Brazil, are sold annually. Japan, China, and Germany are the principal markets, the best grades bringing $500 to $600 per metric ton. The State of Hyderabad, India, has widely distributed deposits of agate, plasma, and bloodstone.

The Iceland spar deposit at Hegustader, Iceland, is still operated as a Government monopoly.

As a result of 1938 political changes, the well-known Bohemian garnet localities and the Czerwenitza opal locality became German territory. It is understood that further working of the Jordansmühl (Silesia) nephrite deposits is to be regulated by the German Government.

In 1936, 13 companies were mining precious stones in Madagascar, although the production only was worth some $21,000. In 1936, 6.6 kilos of beryl, tourmaline, and kunzite were exported (4.5 kilos in 1935 and 9 kilos in 1934) and 31 kilos of feldspar and quartz gems, garnets, and similar stones (16 kilos in 1935, 23 in 1934). In addition much greater weights of industrial stones were exported. The demand is, however, so irregular that exports for a single year mean little.

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The mines are small units, and the use of explosives is avoided lest the gems be ruined.

South-West Africa in 1937 produced 46.765 kilos of precious stones, largely tourmaline. Sales, largely to Germany, were, however, 688.987 kilos. In the first 9 months of 1938, 110.563 kilos were sold for £1,182. The stones included aquamarine, tourmaline, topaz, rose quartz, and chalcedony.

Brazil is the most important producer of the lesser gems, but figures on its 1938 production are not at hand.

## SYNTHETICS

The Gemmological Institute of America in a study of synthetic emeralds finds the best method of distinguishing synthetics from real is the presence of irregular cracklike or wisplike markings in the synthetics, imperfections markedly different from the blemishes of emeralds.[2]

The Russian Precious Stone Trust is now making synthetics in its Leningrad laboratory, several of which, a sapphire of 292 carats and a ruby of 250 carats, are sizable.

The I. G. Farben-Industrie has a large synthetic-gem plant at Bitterfeld, Germany, which produces several thousand carats of synthetics a day. Some are sent to Oberstein for cutting, and others are used as jewels for watches and bearings for precision instruments.

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# MINOR NONMETALS: CARBON DIOXIDE; GRAPHITE; GREENSAND; KYANITE, ANDALUSITE, AND DUMORTIERITE; LITHIUM MINERALS; MEERSCHAUM; MINERAL WOOL; MONAZITE; OLIVINE; SERPENTINE; STRONTIUM MINERALS; TOPAZ; AND VERMICULITE

By Paul M. Tyler [1]

SUMMARY OUTLINE


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| Meerschaum | 1406 | Vermiculite | 1410 |
| Mineral wool | 1407 | | |


## CARBON DIOXIDE

Continued progress was made in the production and use of solid and liquid carbon dioxide in 1938. The volume of business was approximately the same as in 1937, when the output (Census figures) of dry ice was 156,609 tons, valued at $4,618,937, and of liquid or gaseous $CO_2$ (including about 8,500 tons piped to dry-ice plants) 50,358 tons, worth $4,939,508. No radical new uses for either liquid or solid carbon dioxide were developed in 1938, but the use of the latter product for refrigeration continued to expand.

Natural-gas wells suitable for producing solid carbon dioxide are found in several States, and natural dry-ice plants have been built in California, Colorado, New Mexico, Utah, and Washington. Nevertheless, natural gas is a very small factor in the present-day volume of either liquid or solid carbon dioxide produced domestically, because the wells are so far from the population centers that consume the bulk of the products. As evaporation of solid carbon dioxide commences the moment it is made, the economics of distribution of this product differs from that of most commodities. Not only do freight charges add to the cost of distant shipment, but also the volume of the product diminishes more or less inversely with the time of exposure in transit or warehouse. Evaporation losses on large shipments are proportionately less than on smaller lots, but it has never proved economical to transport carbon dioxide to far-away markets. Byproduct gas from limekilns, cement mills, and metallurgical plants is more important than natural gas, largely because such plants are more likely to be situated in or near large cities or towns that afford markets. Over half the liquid carbon dioxide manufactured is made from the combustion of coke, coal, oil, and natural gas.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.



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Geographic location is not the only economic factor. Even by-product gas has comparatively little value unless waste power also is available. A properly designed combustion unit employing coke consumes virtually all the power developed by combustion to purify and compress the liberated gas to liquid and solid forms. However, the utilization of byproduct gas, particularly in localities where surplus power or cheap electricity is available, has been facilitated by improvements in methods of absorption and purification. As stated in Minerals Yearbook, 1938, fully 20,000,000 tons of $CO_2$ are liberated in a normal year at American cement and lime-burning plants alone, and there is little prospect of all this gas being captured successfully and sold at a profit. Both soda and potash solutions are used for absorption and purification of raw gases, and under certain conditions even better results are obtainable by using triethanolamine. The latter absorbent is the basis of the Girbotol process (United States Patent reissue 18958), which protects the use of aliphatic amines for the separation and recovery of acidic gases from gas mixtures. The cycle is identical with the orthodox potassium carbonate cycle, but the reagents have more capacity for carbon dioxide than does inorganic carbonate; moreover, they are more reactive and are easily regenerated. A letter from the Girdler Corporation, Louisville, Ky., states that the Girbotol process is used for the recovery of $CO_2$ in plants having a total installed capacity of 120 tons of carbon dioxide per day. This process is also used to remove carbon dioxide from gas mixtures, and in many plants the $CO_2$ is not recovered commercially. In fact, the quantity so wasted is considerably greater than the total capacity of plants that recover it commercially.

According to H. J. Duncan, of the Geological Survey, the Northwest Natural Gas Corporation at Klickitat, Wash., which has 13 wells producing from depths of 50 to 500 feet, is deepening one of its wells in the hope of obtaining an additional supply of gas. The plant now has a daily capacity of 6 tons, which retails at 3 cents per pound. Liquid carbon dioxide is bottled for soda-fountain consumption, and the company also has a contract to supply a large chain of stores with carbonated water. No treatment is necessary to purify the gas which needs only to be separated from entrained water.

According to State mineralogist Walter W. Bradley,[2] natural carbon dioxide gas was first obtained commercially in California in 1894 at the Santa Isabel shaft of the New Almaden quicksilver mine, Santa Clara County, where a drift on the 575 level was bulkheaded and the gas drawn out through a pipe, compressed in cylinders, and used to make soda water. Since 1933 carbon dioxide gas, produced from wells drilled on the edge of Salton Sea near Niland, Imperial County, has been converted into dry ice and shipped by truck to Los Angeles. The plant has a daily capacity of 10 tons but apparently has never operated at over half this rate.

In Germany dry ice is reported as being used successfully to preserve bakery products in transport or storage.[3] According to a later report from the office of the American commercial attaché in The Hague, dry ice is used quite generally in the Netherlands by large retailers and chain stores to protect confectionery, cakes, pastry, and bread-

[2] Bradley, W. W., California's Commercial Minerals: Min. Cong. Jour., vol. 24, No. 9, September 1938, p. 18.
[3] Bureau of Foreign and Domestic Commerce, World Trade Notes on Chemicals: Vol. 12, No. 47, November 19, 1938, p. 809.

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stuffs, as well as ice cream. It is also used in household refrigerators. The use of dry ice in bakeries was introduced about 2 years ago because the Dutch Government passed a law prohibiting night work, thus preventing delivery of fresh bread in the early morning.

Liquid carbon dioxide derived from natural springs in Ecuador has been offered for sale in Panama.

Experiments at the University of Minnesota on the use of $CO_2$ for the preservation of certain fruits have passed the experimental stage, and for the last 3 years Minnesota growers have been shipping and selling strawberries and raspberries to dealers in surrounding States with considerable success. The berries are reported to be firmer in texture, brighter in color, and far freer from mold than those not gassed.[4] Reviving the idea of stimulating plant growth in greenhouses, and possibly in connection with newly developed methods of soilless cultivation, a University of Colorado professor [5] has called attention to the possibility of piping the gas from natural wells. He suggests that it may even be possible to flood open fields with it. The vast quantities of carbon dioxide available are indicated by the measurement of one gas well in Mexico that discharges 150,000,000 cubic feet of $CO_2$ daily, enough to make 9,000 tons of dry ice. The pressures at some wells approach 1,000 pounds per square inch. Earl S. Johnson,[6] of the Smithsonian Institution, recently has pointed out that increased light intensity as a means of forcing plants to grow faster is only effective up to a certain point because the carbon dioxide naturally present in air does not equal that required during accelerated photosynthesis. He states that the practical application of aerial fertilization with carbon dioxide and the source of supply of carbon dioxide in amounts adequate for field work are still unsolved problems, but that application of carbon dioxide to greenhouse culture appears more promising.

Summarizing the international situation, the foreign correspondent of a Canadian chemical journal [7] observes that the solid carbon dioxide business in the United States and Canada advanced to a certain point and then hesitated owing to complicated economic reasons, whereas in England where the application of refrigeration was less advanced the dry-ice business had a better chance to develop. A substantial tonnage of English $CO_2$ has been used in carrying fish to London from Scotland and on other overnight hauls for which dry ice is especially well-suited. On the other hand, little progress has been made in France and Germany. Norway, however, seems to have the most ambitious plans; there may be quite a development in shipping about Europe fish frozen with carbon dioxide.

## GRAPHITE

Domestic graphite mining, which has been virtually dormant for several years, was animated in 1938 with the completion of a new plant at Morristown, N. Y., by the Long Valley Ore Co. The rock, which is said to run 20 to 25 percent graphite, is ground in a Hardinge ball mill and concentrated by flotation, the rougher concentrates being cleaned in a second battery of cells. The concentrates from the

[4] Industrial and Engineering Chemistry, Chemistry in 1938: Vol. 31, No. 1, January 1939, p. 5.
[5] Germann, F. E. F., $CO_2$ Wells May Yield "Air Fertilizer" for Crops: Science News-Letter, vol. 34, No. 7, August 13, 1938, p. 107.
[6] Oil, Paint, and Drug Reporter, Alcohol News: Vol. 134, No. 13, September 26, 1938, p. 19.
[7] Canadian Chemistry and Process Industries, vol. 23, No. 2, February 1939, p. 70.



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cleaners are thickened to about 20 percent moisture, filtered, and dried. The product runs 85 to 90 percent carbon and is as pure as some of the Ceylon graphites. It is an excellent foundry facing and is also suitable for battery manufacture. A fair proportion of the material is flake, but the flakes are small and apparently unsuitable for crucible making. No detrimental impurities are found in the gangue, and the concentrates are free from all metallic elements except the usual percentage of iron oxide. The capacity of the plant is 15 tons a day but can be increased if demand warrants. The various California producers were idle in 1938, and the Western Graphite Co., Los Angeles, Calif., was dissolved as of December 1. The Graphite Corporation has announced its intention to open a new plant at Shelbyville, Tenn. At Clarkesville, Ga., the Southern Mining & Milling Co. increased its recovery of graphite as a joint product of its kyanite operations. The Texas Graphite Co., Llano, Tex., which was reorganized in 1936, began operations in 1937 and shipped a small amount of crystalline graphite for foundry facings in that year. No production was reported by the company during 1938, but operations may be resumed in 1939. Fully a dozen other companies are carried on the Bureau of Mines records as possible producers of crystalline graphite, but all of them reported that they did not produce during 1938.

As in former years the Carson Black Lead Co. shipped amorphous graphite from its mine near Carson City, Nev., to Oakland, Calif., for use in graphite paint. A somewhat similar operation is conducted by the Detroit Graphite Co., L'Anse, Mich. The leading manufacturer of artificial graphite is the Acheson Graphite Corporation, whose plant is at Niagara Falls, N. Y.

The Bureau of Mines is not at liberty to publish figures of graphite production.

Imports of graphite declined sharply in 1938, aggregating only 17,005 short tons valued at $372,039 compared with 29,593 tons valued at $752,315 in 1937 and 24,171 tons valued at $566,662 in 1936. Exports were 983 tons valued at $112,443 compared with 1,514 tons valued at $163,331 in 1937 and 816 tons worth $114,847 in 1936. Imports of leading items in 1938 (1937 figures in parentheses) were: Artificial graphite, 500 short tons valued at $19,870 (802 tons, $31,562); natural amorphous, 14,676 tons, $247,789 (25,354 tons, $512,162); Ceylon lump and chip, 41 tons, $3,074 (482 tons, $41,499); dust, 168 tons, $10,643 (321 tons, $17,600); and flake, 1,620 tons, $90,663 (2,634 tons, $149,492). All artificial graphite comes from Canada. In 1938 Mexico supplied two-thirds of the imports of natural amorphous graphite; shipments from Ceylon and Japan (Chosen) to this country were much less than in 1937. Imports of dust were furnished by Ceylon and Madagascar in roughly equal proportions. As usual most of the flake graphite was from Madagascar or France.

Under the trade agreement with the United Kingdom, effective January 1, 1939, the duty on amorphous graphite was cut from 10 percent to 5 percent ad valorem and that on Ceylon lump, chip, and dust likewise was halved, from 30 percent to 15 percent ad valorem. Effective June 15, 1936, the rate on flake graphite was reduced under the trade agreement with France; the previous rate, under the tariff act of 1930, was 1.65 cents a pound and the new rate is 30 percent ad

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valorem with the proviso that this shall not be less than 0.825 nor more than 1.65 cents per pound.

Prices of graphite tended to be somewhat lower in 1938 than in 1937, but the quotations did not differ greatly from those reported in Minerals Yearbook, 1938.

*World production of natural graphite, 1910–14, 1925–29, 1930–34 (5-year averages), and 1935–37, in metric tons*

[From data compiled by M. T. Latus]

| Country | 1910–14 (average) | 1925–29 (average) | 1930–34 (average) | 1935 | 1936 | 1937 |
|---|---|---|---|---|---|---|
| Argentina | | | | | 18 | (1) |
| Australia: | | | | | | |
| New South Wales | 1 | 12 | 18 | 30 | | |
| Queensland | | | | 14 | 23 | 12 |
| South Australia | | | 15 | | | 2 |
| Brazil [2] | 1 | 4 | 4 | 2 | | 9 |
| Canada | 1,548 | 1,756 | 790 | 1,617 | (3) | (3) |
| Ceylon [2] | 27,226 | 13,618 | 8,677 | 14,131 | 13,731 | 17,660 |
| Chosen [2] | [4] 11,846 | 18,484 | 23,721 | 44,698 | 40,914 | 39,800 |
| Czechoslovakia | | 29,276 | 4,187 | 1,870 | 2,926 | 5,144 |
| France | 603 | 734 | 46 | | | |
| Germany: | | | | | | |
| Austria | 34,094 | 19,083 | 14,653 | 19,490 | 21,710 | 18,158 |
| Bavaria | 8,660 | 17,548 | 21,333 | 21,663 | 24,290 | 23,544 |
| Greenland | | | | | | 60 |
| India, British | 1,686 | 8 | 71 | 566 | 394 | 567 |
| Indochina [2] [5] | | 289 | | | | |
| Italy | 11,603 | 8,487 | 3,997 | 5,153 | 5,200 | 5,411 |
| Japan | 330 | 578 | 572 | 1,201 | 1,576 | (1) |
| Madagascar [2] | 4,750 | 14,141 | 6,111 | 8,046 | 8,570 | 12,387 |
| Mexico | 3,170 | 5,699 | 3,521 | 6,976 | 10,254 | 11,210 |
| Morocco, French [2] | | 21 | 108 | 238 | 236 | 152 |
| Norway | 212 | | 1,206 | 2,642 | 3,630 | 3,638 |
| Spain | | 580 | | | | |
| Sweden | 334 | | | 69 | 63 | 25 |
| Union of South Africa | 36 | 51 | 53 | 66 | 59 | 63 |
| U. S. S. R | (1) | 3,992 | [6] 32,333 | 83,700 | (1) | (1) |
| United States: | | | | | | |
| Amorphous | 1,571 | 2,840 | (7) | (7) | (7) | (7) |
| Crystalline | 2,196 | 2,133 | (7) | (7) | (7) | (7) |
| Total [8] | 109,867 | 139,334 | 121,416 | 212,172 | 133,594 | 137,842 |

[1] Data not available.
[2] Exports.
[3] Production data not available; value reported as follows: 1936, $88,812; 1937, $125,343.
[4] Average for 1913–14; production data for 1910–12 not available; value reported as follows: 1910, $56,719; 1911, $65,727; 1912, $82,108.
[5] Concentrates.
[6] Average for 1932–34; data for 1930–31 not available.
[7] Bureau of Mines not at liberty to publish figures.
[8] Total of figures given in table only, probably incomplete.

Small amounts of graphite are produced in many countries, from Greenland (60 metric tons in 1937) to the Union of South Africa (63 tons in 1937). A half-dozen countries or more are fairly large producers, but in recent years none of them has challenged the supremacy of Ceylon and Madagascar as producers of high-grade graphite. Of a world total annual output of 200,000 tons, the U. S. S. R. recently has been credited with over 40 percent; Germany and Austria (combined), over 20 percent; Chosen, 20 percent; and Mexico, 5 percent. However, the bulk of the product in these countries is low-priced amorphous graphite, much of which is used only locally. Although the tonnage mined in Ceylon and Madagascar seldom exceeds 15 percent of the world total the value of their outputs is probably at least half the world total.

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## GREENSAND

The domestic production of greensand in recent years has been in New Jersey, chiefly by 3 companies although 1 or 2 other producers are more or less active. Shipments of refined greensand decreased in 1938 to 6,576 short tons valued at $152,000 compared with 9,734 tons worth $211,000 in 1937; the annual average for the 1925–29 period was 12,715 tons valued at $197,200. The valuation figures are partly estimated because a substantial part of the output is further processed by the producers and sold as water-softening compounds worth up to $115 a ton. Formerly considerable quantities were used for fertilizer, but this use has almost disappeared. The best grade of refined greensand (carload lots, screened and bagged) has been quoted in Engineering and Mining Journal at $20 per short ton, f. o. b. cars, for several years.

Properly processed greensand occupies a unique position in the water-softener field. Owing to its extremely high rate of exchange, it softens water as rapidly as the water can be forced through it. Since no synthetic zeolite yet seems to have approached this speed of reaction and since its speed of regeneration is equally great, greensand largely supplanted products prepared by a fusion synthesis. The historical development of the zeolite or base-exchange principle and additional information on the properties of greensand and other zeolite softeners are discussed briefly in Bureau of Mines Bulletin 328, which contains an annotated bibliography of the literature published before 1930.[8] This bulletin is out of print but may be consulted in libraries of most of the large cities of the United States. Additional information may be found in the trade literature issued by the filter companies that supply the processed materials.

Natural zeolites comprise a group of silicate minerals all of secondary origin and usually found in seams or cavities of basic igneous rocks. This group includes apophyllite, stilbite, chabazite, analcite, and natrolite, which, however, are of interest only to the mineralogists and are seldom, if ever, found in minable quantities.

Most clays are capable of some zeolitization, and a claylike material from one of the Faroe Islands (Denmark) flakes down and is suitable for use in water softeners.

Indicative of the growing market for water-softening chemicals are the Bureau of Census reports of shipments of water-softening apparatus for domestic use, which have increased steadily from a monthly average of 273 units in 1933 to 1,066 in 1937; the monthly average for 1938 was 1,027 units.

## KYANITE, ANDALUSITE, AND DUMORTIERITE

Notwithstanding the depressed condition of many of the consuming industries, domestic production of kyanite showed further progress in 1938, although imports of "kyanite and sillimanite" decreased to 3,964 short tons valued at $32,458 compared with 7,674 short tons and $79,410 in 1937, the first year for which statistics are available. British India has been almost the only foreign source of kyanite or its allied minerals sillimanite, andalusite, and dumortierite. However,

[8] Shreve, R. N., Greensand Bibliography to 1930 (Annotated), with a Chapter on Zeolite Water Softeners: Bureau of Mines Bull. 328, 1930, 78 pp.

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kyanite schists in the U. S. S. R. are reported [9] to be suitable for refractories, and in December 1938 the Bureau of Mines was asked to advise regarding possible markets in the United States for South African andalusite averaging 57 percent $Al_2O_3$ and containing 1.1 percent $Fe_2O_3$ and 0.1 percent MnO. These deposits, which were described in a bulletin [10] of the Department of Mines at Johannesburg, occur in the Zeerust and Marico Districts of western Transvaal, some of the best material being found along the Doorn River (part of the Marico drainage system) where it flows over the lowest horizons of the Pretoria series.

According to a report of the Imperial Institute (Bull. 36, pp. 493–498) recent discoveries in Nyasaland suggest that alternative supplies of kyanite may be available from that country. Deposits in British East Africa may be regarded as potential sources, although perhaps at present material could not be landed at United Kingdom ports at less than £5 a ton. Samples of good-quality kyanite have been received at the Imperial Institute from Kenya, and the producer claimed that he could make shipments at the rate of 100 tons a week. In Western Australia kyanite is abundant in the Chittering Valley 40 miles from Perth.

The leading domestic producer of kyanite, Celo Mines, which boosted capacity to 15 tons of kyanite concentrates a day, operated steadily during 1938 although at a reduced rate owing to the shrinkage in sales to refractory manufacturers. Further major changes in the flow sheet are contemplated in order to yield some entirely new products, including an especially low-iron kyanite that may be used directly in electrical porcelain glazes and as an ingredient in glass. Byproduct garnet has become an important credit item, and experimental work has been conducted to devise means of utilizing the mica which, however, is mostly biotite. The quartz at this property is thermally luminescent, and it is thought that some day this peculiar phenomenon may find a useful application.

The Phosphate Recovery Corporation pilot mill on Baker Mountain near Pamplin, Va., was remodeled again. Owing to the losses experienced by straight gravity concentration, wet tabling has been supplemented by froth flotation, and bleaching tests have been made to lower further the iron content of material drawn from certain parts of the deposit.

At Clarkesville, Ga., the Southern Mining & Milling Co. produced kyanite from schists by its mulling process recently patented (U. S. Patent 2105597, January 1938) by Philip S. Hoyt. E. C. Noble, New Florence, Mo., reported that he was building a mill near Clarkesville, Ga., to produce both kyanite and vermiculite from schist. B. J. Lachmond shipped a few cars of kyanite from Henry Knob, S. C. Other domestic producers include the Vitrefrax Corporation of Los Angeles with mines at Ogilby, Calif., and the Tillotson Clay Products Co., Los Angeles (mines in California and Nevada). The latter organization has produced andalusite near Hawthorne, Mineral County, Nev.

The leading andalusite mine in the world, however, is operated by Champion Sillimanite, Inc., in the White Mountains, Calif. This

[9] Borisov, P. A., Kyanite of the Kola Peninsula and the Problems of Highly Refractory Materials: Razvedka Nedr. 1937, No. 12, pp. 1–5. (Ceram Abs., vol. 17, No. 7, July 1938, p. 262).

[10] Partridge, F. C., The Andalusite Sands of the Western Transvaal: Union of South Africa Dept. of Mines, Geol. Series Bull. 2, 1934, 16 pp.

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company is a subsidiary of the Champion Spark Plug Co., Detroit, Mich., whose laboratory-porcelain and thermocouple protection-tube business has been sold to the Coors Porcelain Co., Golden, Colo. The company also has a dumortierite property in Oreana, Nev., which is credited with a total output of 4,500 tons up to and including the 1938 production. This figure is probably also the aggregate world output to date. The andalusite mine is high on the west slope of White Mountain Peak above the little town of Laws, Inyo County, Calif., close to the Nevada line and not far from Bishop, Calif. The mineral occurs in irregular lenses largely on the footwall of the quartz monzonite dike. The original outcrop was on the walls of a cliff so steep that miners at first had to be lowered on ropes. The ore is hand-sorted and transported by muleback to shipping bins 3 miles away and 3,000 feet lower.[11]

Production figures for kyanite and related minerals are not available.

The function of dumortierite in spark-plug insulators and electrical porcelain is to increase the electrical resistivity and widen the burning range. Dumortierite refractories swell slightly when fired; however, contrary to published statements dumortierite is not used in spark-plug cores to overcome any tendency of andalusite to sag but because it is almost indispensable in the product. Dumortierite is valuable for use in such places as the spout for a glass tank, where it seems to resist the eroding effect of the glass remarkably well.

Prices of kyanite were reduced at the beginning of 1939. For regular refractory grades the cut was as much as 40 percent; for high-grade white-burning products it was less. Throughout most of 1938 Celo Mines was offering a 98-percent kyanite, white-burning concentrate, calcined and ground to 325-mesh and carrying only about 0.1 percent $Fe_2O_3$.

## LITHIUM MINERALS

The Bureau of Mines has resurveyed the Nation's resources of low-grade lithium ores and has developed methods for concentrating them and extracting lithium compounds, thereby demonstrating that raw-material supplies afford no handicap to rapid expansion in commercial utilization of the metal and its salts. Only a few years ago lithium was thought to occur only in small, widely scattered deposits and consequently seemed destined to remain one of the rarer elements, but now it may be regarded as one of the cheaper, readily available metals. In 1938 an interesting report [12] on lithium occurrences in Maine and Massachusetts was published. A good description of the Harding mine in Taos County, N. Mex., which produced as much as 12,000 tons of lepidolite before it closed in 1930, has been issued by the State Bureau of Mines and Mineral Resources.[13] Although the ore shoot that was worked in the past may be mined out, a well-conducted exploration program probably would disclose other shoots that could be exploited.

The mine production of lithium minerals in the United States decreased sharply in 1938, but this was more than offset by the recovery of lithium from a new and heretofore unsuspected source,

[11] d'Arcy, N. A., Jr., A Rocks and Minerals Outing to Owens Valley, Calif.: Rocks and Minerals, vol. 14, No. 3, March 1939, p. 73.

[12] Hess, F. L., and Ralston, O. C., Lithium in New England: Eng. and Min. Jour., vol. 139, No. 6, June 1938, pp. 48–49.

[13] Just, E., Geology and Economic Features of the Pegmatites of Taos and Rio Arriba Counties, N. Mex.: New Mexico Sch. Mines Bull. 13, 1937, pp. 26–30, 33–35.

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namely, as a byproduct of the complex brine-refining operations in California (at Searles Lake) which yield potash, sodium sulfate, soda ash, and borax as coproducts. The total production of lithium compounds, as given by producers to the Bureau of Mines, aggregated 892 short tons valued at $329,088 compared with 1,357 tons valued at $36,206 in 1937 and 1,241 tons worth $34,273 (revised figures) in 1936. Although the tonnage was much less in 1938 than in earlier years, the value was almost 10 times as great because the average lithium content was increased greatly owing to inclusion of the lithium phosphate recovered at Trona, Calif., by the American Potash & Chemical Corporation.

Three producers reported shipments of lithium ores from South Dakota in 1938. Amblygonite, lepidolite, and spodumene were shipped from Keystone, Pennington County, where the Etta mine was operated by the Maywood Chemical Works and the Ingersol mine by the Black Hills Keystone Corporation. Amblygonite was also shipped from the Tinton mine of the Black Hills Tin Co., at Tinton. Small quantities of lithium ores were produced from other properties in South Dakota and North Carolina but not shipped.

*Lithium compounds produced and shipped in the United States, 1929–38*

| Year | Number of producers | Short tons | Value | Year | Number of producers | Short tons | Value |
|---|---|---|---|---|---|---|---|
| 1929 | 2 | (1) | (1) | 1934 | 5 | 719 | $20,980 |
| 1930 | 5 | 1,797 | $56,327 | 1935 | 4 | 1,154 | 26,834 |
| 1931 | 2 | (1) | (1) | 1936 | 6 | [2] 1,241 | [2] 34,273 |
| 1932 | 2 | (1) | (1) | 1937 | 7 | 1,357 | 36,206 |
| 1933 | 6 | 504 | 12,997 | 1938 | 4 | 892 | 329,088 |

[1] Bureau of Mines is not at liberty to publish figures.
[2] Revised figures.

The first production of lithium ore in Canada came from deposits at Bernic Lake, Manitoba, in 1937. The entire output (mainly lepidolite and spodumene) valued at $1,694 was shipped to the United States. The Canada Bureau of Mines reported a discovery of spodumene near Falcon Lake 85 miles east of Winnipeg, which carries enriched portions that are considered minable. Lepidolite from the Silver Leaf deposits in Manitoba contains substantial quantities of cesium and rubidium. Amblygonite, as well as spodumene and lepidolite, was being prospected in 1938 in the Lac du Bonnet district in Quebec.

South-West Africa and France are the largest producers of lithium ores outside of the United States. Formerly amblygonite was mined extensively in the Spanish Peninsula, but in recent years shipments from Spain and Portugal have virtually ceased. During the first half of 1938 no lepidolite was produced in South-West Africa, whereas in the similar period of 1937 there was an output of 745 long tons averaging 3.75 percent $Li_2O$; however, the output of amblygonite (8.5 percent $Li_2O$) jumped to 170 tons compared with 35.7 tons. These minerals, all produced at Jooste lithium mine, are exported to the United Kingdom, France, Germany, and the United States. During the entire year of 1937 the output of lepidolite was 1,030 tons and of amblygonite 220.7 tons. In 1936 no amblygonite was shipped, but the lepidolite output was 852 tons. Export valuations for

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lepidolite declined in 1938 to less than £2 10s. (about $12.50) a long ton as against £2 15s. in 1937; the reported value for amblygonite increased slightly to almost £10 or about $50 a ton.

The increase in the use of lithium chloride as an air desiccant has been disappointingly slow. Although this outlet and various other uses of the salts or the metal itself continue to afford promise of much greater development, interest recently has centered more upon ceramic uses. According to Betz [14] the chief advantages of lithium in ceramic formulas are: (1) It is a powerful flux especially in conjunction with feldspar; (2) in certain glasses of low thermal expansion it permits the use of much less alkali; (3) it enables the production of glasses of high electric resistance and desirable working properties; (4) a high $Li_2O$ content aids in producing glasses that transmit ultraviolet light; (5) it has a strong mineralizing effect in ceramic bodies; (6) replacing PbO by $Li_2O$ reduces the tendency for a glaze to vaporize; and (7) it lowers the maturing temperature and greatly increases the fluidity and gloss of enamels and glazes.

Spodumene expands in whiteware bodies, and if properly controlled this expansion may offset shrinkage and other production troubles. Lepidolite hardens and toughens clear glass and lowers the expansion coefficient. Formerly lepidolite was used chiefly in place of cryolite in opal and white glass, but recently it has been receiving attention as a constituent of heat-resisting, low-expansion, and nonshattering glass; it is a powerful flux and brings potash and fluorine as well as lithia and aluminum into the bath.

According to Preston [15] variation in the composition of natural lithium minerals has led to the use of chemically prepared salts in ceramic work; the most important of these is the carbonate, which has wide application in the production of better-quality glazes. Addition of 1 percent or more lithium carbonate to dinnerware and sanitary-ware glazes increases gloss, and in electrical porcelain this compound produces a glaze of high strength and weather resistance. In glazes, as well as in glassmaking, the high fluidity imparted by lithium additions increases the workable range of other desirable addition agents. To obtain a similar degree of fluidity requires smaller proportions of lithia than of potash or soda. An interesting development is the use of molten lithium nitrate as an etching agent on glass. Glasses of high lithia content possess greater transmission of ultraviolet light.

Single crystals of lithium fluoride are grown up to 2,200 grams in weight. These afford an excellent substitute for optical fluorite which is becoming scarce, especially in large sizes. In 1938 the Harshaw Chemical Co.[16] undertook to manufacture these new crystals, employing the technique originally developed in the physical laboratories at Harvard University and the Massachusetts Institute of Technology. Large crystals of rock salt and sodium nitrate also are produced for optical uses.

## MEERSCHAUM

Apparently world supplies of crude meerschaum in recent years have come exclusively from the Eskishehir deposits in Turkey. Imports into the United States in 1938 were 3,559 pounds valued at $9,221

[14] Betz, Geo. C., Lithium Minerals and Compounds in Ceramics: Jour. Am. Ceram. Soc., vol. 21, No. 5, 1938, pp. 189–191; Chem. Abs., vol. 32, No. 13, July 10, 1938, p. 5169.
[15] Preston, E., Lithium in Glass and Ceramics: Foote-Prints, vol. 11, No. 1, July 1938, pp. 1–15.
[16] Industrial and Engineering Chemistry, News Ed., vol. 16, No. 21, November 10, 1938, p. 584.

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compared with 3,687 pounds worth $12,681 in 1937. The average import valuation of $2.59 in 1938 compares with $3.44 in 1937, a minimum of $1.36 in 1924, and a maximum of $4.09 in 1934.

According to a recent report to the Bureau of Mines a commercially promising deposit of meerschaum has been found in the State of Washington. A few scattered deposits had been known previously in the United States. Domestic production has totaled perhaps 1,000 tons, chiefly from a mine near Sapillo Creek, N. Mex., which ceased to be worked about 1914.

## MINERAL WOOL

Notwithstanding a further large increase in productive capacity and some improvement in contracts for residential and certain other kinds of building construction, the output of mineral wool in the United States apparently dropped in 1938. Actual figures are not available, but those in close touch with the industry have estimated that the reduction was 20 percent or more compared with 1937. A leading development was the construction of a huge new plant by Johns-Manville Corporation near Long Beach, Calif. The raw material for this plant is wollastonite mined in Rademacher district near Randsburg. Among other new plants are those of the Edwards Insulation Co., Temple, Tex.; the Northern Rock Wool Co., Pontiac, Mich.; the P. J. Sonner Burner Co., Winfield, Kans.; the Kentucky Stone Co., Mullins, Ky.; and the Ohio Valley Rock Asphalt Co., Summit, Ky. Several existing plants were modernized and expanded; by the simple process of adding another tap hole, the capacity of individual cupolas has been doubled. J. R. Thoenen, of the Bureau of Mines, estimates that there are about 160 cupolas capable of making rock or slag wool in the United States; at least 60 companies operate 70 or more plants in various parts of the country. Productive capacity is approximately 600,000 tons annually, whereas the output in 1938 did not exceed 400,000 tons and possibly was much less. It is estimated that the total output is now divided almost evenly among the three types of products—nodulated (granulated) wool, loose wool, and batts.

The only available statistics of the mineral-wool industry are the biennial figures of the Bureau of the Census, which has reported a total value of $8,279,374 for the production of "mineral wool (other than asbestos) for building insulation" in 1937 compared with $7,786,285 (revised figures) in 1935, $1,714,171 in 1933, $2,873,230 in 1931, and $2,377,324 in 1929. A break-down of the latest figures shows an increase in value for rock wool from $3,361,446 in 1935 to $4,989,117 in 1937 and for slag wool from $1,184,946 to $2,474,295, whereas for "other" mineral wool there was a sharp decline from $3,239,893 in 1935 to only $815,962 in 1937. Glass wool, however, was included in still another blanket classification and the exact nature of the material covered in this category is not revealed.

The production of glass wool and fibers has increased greatly, and their uses have become more diversified. Of wide interest is the employment of glass "mulching wool" for the winter protection of plants. Supplied in strips, 2 inches thick, like cotton batting, it affords better protection than snow, weighs only one-fourth as much, and lasts 3 winters. In 1938 the two domestic producers of glass fibers, the Corning Glass Works and the Owens-Illinois Glass Co.,

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combined their business in the glass-fiber field under the name of the Owens-Corning Fibre Glass Co., a jointly owned but otherwise independent corporation.

## MONAZITE

Imports of monazite into the United States increased slightly in 1938 to 456 short tons valued at $18,210, of which 339 tons valued at $14,402 were from British India, 110 tons valued at $3,421 from Brazil, and 7 tons valued at $387 from the United Kingdom. In 1937 the imports were 336 tons valued at $13,579 compared with 607 tons and $25,324 in 1936. No domestic output has been recorded since 1925. Prices, as reported by the Engineering and Mining Journal, remained unchanged at $60 to $75 a short ton (basis, 8 percent $ThO_2$) until late in the year when they narrowed to $60 to $70 a ton.

## OLIVINE

Dunite deposits of commercial importance are found in California, Washington, and North Carolina. The North Carolina deposits are the largest and contain the most adaptable material. They contain probably 50 to 100 million tons of olivine suitable for the manufacture of forsterite refractories and recently have produced as much as 600 tons a month, a figure that could promptly be increased to keep pace with any reasonable expansion in demand. Exact figures are not available, but shipments in 1938 declined slightly, being estimated at less than 2,000 tons. There are two quarries, both in Jackson County, N. C.

Greaves-Walker and Stone [17] have summarized available information on olivine and reported their successful search for suitable binders for olivine refractories.

## SERPENTINE

Attractively colored and veined serpentine is marketed as verde antique for building trim and various ornaments. Chips may be used in terrazzo or sold as roofing granules. Recently, however, the Bureau of Mines has received a number of inquiries as to possible other uses, especially for ground serpentine.

Enormous quantities of serpentine, much of it pulverized into an almost impalpable powder, are blown out of the chrysotile asbestos mills in Canada and Vermont. However, as yet, asbestos dust has found only a limited use. It has been employed in conjunction with short-fiber asbestos in various cements and to a very small extent as a filler in miscellaneous products. Recent inquiries seem to be regarding possible use of the material as a refractory, although, as has been pointed out frequently, ordinary serpentine is not a particularly high-melting material and suffers from the further disadvantage of containing much combined moisture that is driven off at a relatively low temperature. Moreover natural serpentine rarely approaches the theoretical formula, $3MgO.2SiO_2.2H_2O$ with 43 percent MgO. Ordinarily it contains 2 to 8 percent iron oxide and substantial quantities of silica, alumina, and other impurities. Both because of these impurities and because of the relatively large content of combined water, it would seem impossible to substitute serpentine success-

[17] Greaves-Walker, A. F., and Stone, R. L., The Production of Unfired and Fired Forsterite Refractories from North Carolina Dunites: North Carolina State Coll. Eng. Exp. Station Bull. 16, September 1938, 123 pp. (Abstracted in Bureau of Mines Mineral Trade Notes, vol. 8, No. 2, Feb. 20, 1939, pp. 19–20).

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fully for other magnesium silicate minerals of somewhat similar composition, such as olivine (which is anhydrous), talc ($3MgO.4SiO_2.H_2O$), or even soapstone (an impure talc). Additional information as to possible uses for serpentine therefore will be awaited with interest.

Another inquiry relates to antigorite, a form of serpentine that has a platy rather than fibrous or asbestiform structure. As reported in the magazine Asbestos (December 1938, p. 38), a substantial deposit of relatively pure antigorite has been located in California, near Stockton. The same deposit also contains a mixture of pure antigorite and short-fiber asbestos that could be mined commercially.

## STRONTIUM MINERALS

Available information on the strontium industry has been summarized in recent volumes of Minerals Yearbook; a general review appeared in Minerals Yearbook, 1935 (p. 1232). Bureau of Mines Economic Paper 4, Strontium from a Domestic Standpoint, is somewhat out of date but may be purchased from the Superintendent of Documents, Government Printing Office.

Strontium salts, notably nitrate, are used in the United States almost exclusively in pyrotechnics, the chief outlet being the red flares used by railway companies and truckers as warning signals.

A number of firms have indicated to the Bureau of Mines that they are possible producers of strontium minerals, and domestic resources of celestite are undoubtedly large. During 1938 the Bureau of Mines received many inquiries as to possible markets for strontianite, which recently seems to have been found in Gunnison County, Colo., near Parlin and in New Mexico. No domestic production of strontium ore has been reported since 1918, and domestic needs are supplied by imports. However, the Mudrite Products Co. of Houston, Tex., has recently mined impure celestite near Sweetwater, Tex., and ground it at Nacogdoches, Tex., for use as a new oil-well drilling mud admix. An analysis shows over 82 percent $SrSO_4$.

Except for an unimportant increase for precipitated carbonate, imports of strontium ores and compounds declined sharply in 1938. Imports for 1938 (1937 in parentheses) follow: Strontianite and (chiefly) celestite, 552,868 pounds valued at $2,824 (5,636,570 pounds, $20,877); strontium nitrate, 364,362 pounds, $23,921 (609,488 pounds, $40,243); and precipitated carbonate (this classification nominally includes oxide as well), 82,859 pounds, $8,502 (44,579 pounds, $4,610).

## TOPAZ

Topaz is best known as a gem mineral but is not uncommon as a minor constituent of granites. Colorless topaz bears a superficial resemblance to quartz and is even more likely to be confused with phenacite, the illusive beryllium mineral that thus far has not been found in commercial quantities although often reported. Topaz is usually, but not always, harder than quartz and differs from quartz in that it has perfect basal cleavage.

A unique occurrence of massive topaz recently was discovered in the Brewer gold mine near Jefferson, Chesterfield County, S. C. According to a Geological Survey report [18] this deposit contains an

[18] Pardee, J. T., Glass, J. J., and Stevens, R. E., Massive Low-Fluorine Topaz from the Brewer Mine South Carolina: Am. Mineral., vol. 22, No. 10, October 1937, pp. 1058–1064.

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enormous quantity of topaz unusually fine-grained in texture and low in fluorine. The hardness is only 7 (usually 8), and the specific gravity is the lowest ever recorded for topaz, probably owing to the low fluorine content (13.23 percent F). The percentage of silica is only 33, and that of $Al_2O_3$ is reported as 56.76 (some of which, however, represents $AlF_3$).

Attention has been given to commercializing the material, possibly as a refractory.

## VERMICULITE

An outstanding development in the vermiculite industry in 1938 has been the progress in the utilization of smaller sizes. In Minneapolis, which has long been a leading market and where three expanding plants are now producing house fill, important sales of vermiculite plasters have been made recently. The vermiculite replaces the fiber and part of the sand, and the product has good heat- and sound-insulating properties. Of special interest is its use in school buildings to prevent transmission of noise by the steel framework. The fire resistance of such plasters is superior to that of plasters made from larger pellets of vermiculite which sometimes expand further when strongly heated, thereby causing cracks. Hitherto, sizes smaller than those used for loose house fill (minus 3- plus 14-mesh) have been difficult to dispose of, often having been thrown away at the mines, but other new uses are developing for finer sizes in conjunction with fireclay and bentonite for special refractories, including combustion chambers for oil-burner equipment. Visitors to the San Francisco World Fair will see expanded vermiculite sparkling in the walls of the buildings. To impart a distinctive finish to the 200,000 square yards of exterior stucco 140 tons of vermiculite, especially heat-treated to a bright golden color, was applied while the cement stucco was still wet.

These new uses failed to offset the decline in demand for home insulation, previously noted for mineral wool.

*Vermiculite sold or used in the United States, 1936–38*

| Year | Short tons | Value | |
|---|---|---|---|
| | | Total | Average per ton |
| 1936 | 16,933 | $185,787 | $10.97 |
| 1937 | [1] 26,556 | [1] 260,664 | [1] 9.82 |
| 1938 | 20,700 | 192,000 | 9.28 |

[1] Revised figures.

In 1938 raw vermiculite was produced commercially in the United States by two companies in Montana and one each in Colorado and Wyoming. Another concern made trial shipments from North Carolina. Although all the mining companies sell cleaned raw vermiculite, most of them have acquired one or more expanding plants so that they can sell their product more directly to the consumer. Prices of the raw material are approximately $12 f. o. b. Western mines and nominally $6 or $7 a ton f. o. b. North Carolina.

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# PART IV. MINE SAFETY

## EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. Adams

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The outstanding feature of the mineral industry of the United States in 1938 was a decline of 8 percent in the number of men employed, accompanied by an even more pronounced reduction in the number of man-hours worked—22 percent. Fortunately, this loss in employment was accompanied by a decreased number of accidents to employees. The reduction in accidents was proportionately greater than the decline in man-hours, so that the accident-frequency rate for a given exposure to occupational hazards was slightly more favorable in 1938 than in 1937.

Of the 21 branches of the mining industry for which separate figures have been compiled, 16 reported a decrease in the number of men employed and 5 showed virtually no change or possibly a slight gain in the number of workers. The five classes of operations that showed little or no loss in the number of workers were gold and silver mines, cement mills and quarries, limestone quarries, trap-rock quarries, and nonmetallic-mineral mines.

These general statements are based upon a comparison of reports covering identical plants for the 3 years 1936–38, inclusive. The plants selected were those for which reports for 1938 had been received in time for review in the current issue of Minerals Yearbook. The reports cover from 35 to 97 percent of the number of men employed in the 21 branches of the mineral industries to which the figures relate. Reports for bituminous-coal mines, the largest group of operations, covered 60 percent of the total number of workers.

The following table shows the number of men employed from 1936 to 1938, inclusive, in each of the 21 branches of the mining and allied industries. All figures for 1936 are complete and final, as are the 1937 figures for quarries, coke ovens, iron mines, copper mines, and anthracite mines. All other figures for 1937 and all figures for 1938 are subject to revision.



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*Number of men employed in the mineral industries of the United States, 1936–38*

| | 1936 | 1937 | 1938 [1] |
|---|---|---|---|
| Coal mines: | | | |
| Bituminous-coal | 482,500 | [1] 507,000 | 469,000 |
| Pennsylvania anthracite | 102,082 | 99,085 | 95,000 |
| | 584,582 | [1] 606,000 | 564,000 |
| Metal mines: | | | |
| Iron | 18,592 | 22,957 | 18,100 |
| Lead-zinc (Mississippi Valley) | 5,689 | [1] 7,300 | 6,600 |
| Copper | 14,102 | 21,200 | 17,800 |
| Gold, silver (including lead, zinc, copper) | 47,967 | [1] 52,000 | 52,700 |
| Miscellaneous (tungsten, manganese, etc.) | 3,195 | [1] 4,500 | 3,600 |
| | 89,545 | [1] 108,000 | 99,000 |
| Nonmetallic-mineral mines | 11,387 | [1] 12,000 | 11,000 |
| Quarries: | | | |
| Cement | 26,004 | 27,215 | 27,600 |
| Quarries—Continued. | | | |
| Marble | 3,304 | 3,647 | 3,400 |
| Slate | 2,565 | 3,074 | 2,600 |
| Trap-rock | 3,111 | 2,806 | 2,800 |
| Granite | 8,243 | 8,961 | 8,200 |
| Sandstone | 3,122 | 3,242 | 2,700 |
| Limestone | 24,288 | 24,789 | 24,900 |
| Lime | 9,385 | 10,360 | 8,500 |
| | 80,022 | 84,094 | 81,000 |
| Coke ovens: | | | |
| Byproduct | 16,286 | 17,850 | 12,600 |
| Beehive | 1,525 | 2,192 | 1,200 |
| | 17,811 | 20,042 | 14,000 |
| Metallurgical plants: | | | |
| Mills | 13,003 | [1] 15,300 | 11,400 |
| Smelters | 16,160 | [1] 17,900 | 14,400 |
| Auxiliary works | 12,004 | [1] 14,900 | 12,200 |
| | 41,167 | [1] 48,100 | 38,000 |
| Grand total | 824,514 | [1] 878,000 | 806,000 |

[1] Subject to revision.

A summary table showing number of men employed, number of man-days worked, number of men killed by accidents, and yearly fatality rates for the mining and quarrying industries from 1911 to 1935 was published in Minerals Yearbook, 1937 (p. 1454). The following table contains similar data for 1931 to 1938, inclusive, not only

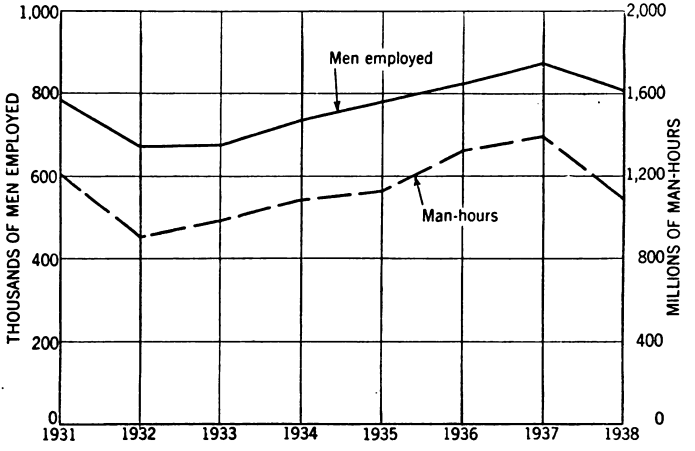


FIGURE 1.—Trend of employment in the mineral industries of the United States, 1931–38.

for mines and quarries but also for coke ovens, ore-dressing plants, smelters, and auxiliary works associated with ore-dressing plants and smelters. In addition, the table contains figures showing the number of nonfatal injuries and the nonfatal-injury rates. Figure 1 shows the trend of employment in the mineral industries since 1931, and figures 2 and 3 indicate the trend of accidents and accident rates, 1931–38.

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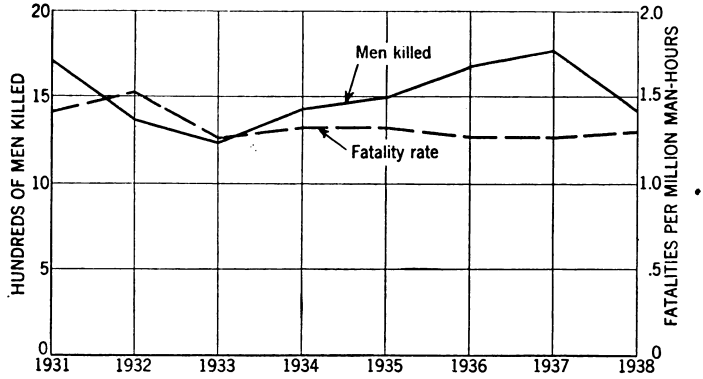


FIGURE 2.—Trend of fatal accidents in the mineral industries of the United States, 1931–38.

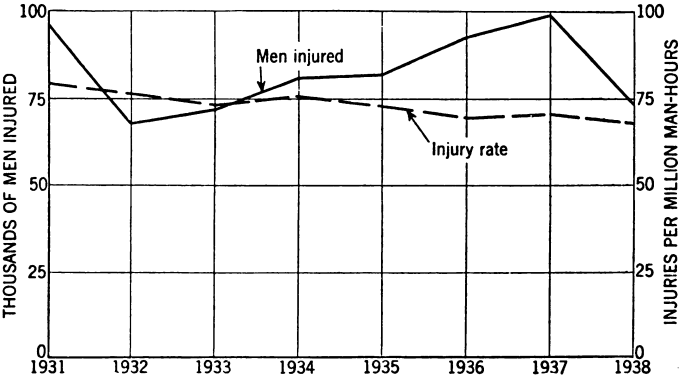


FIGURE 3.—Trend of nonfatal accidents in the mineral industries of the United States, 1931–38.

*Employment and accident record of mineral industries of the United States, 1931–38*

| Year | Number of men | Man-days of employment | Man-hours of employment | Number | | Rate per million man-hours | |
|---|---|---|---|---|---|---|---|
| | | | | Killed | Injured | Killed | Injured |
| 1931 | 784,347 | 147,602,799 | 1,209,270,036 | 1,707 | 96,412 | 1.41 | 79.73 |
| 1932 | 671,343 | 110,655,616 | 900,211,723 | 1,368 | 68,717 | 1.52 | 76.33 |
| 1933 | 677,722 | 122,787,658 | 984,570,160 | 1,242 | 72,342 | 1.26 | 73.48 |
| 1934 | 739,817 | 144,566,133 | 1,081,694,716 | 1,429 | 81,660 | 1.32 | 75.49 |
| 1935 | 783,139 | 152,354,170 | 1,128,808,465 | 1,495 | 82,219 | 1.32 | 72.84 |
| 1936 | 824,514 | 177,920,334 | 1,326,347,029 | 1,686 | 92,644 | 1.27 | 69.85 |
| 1937 [1] | 878,000 | 190,000,000 | 1,394,000,000 | 1,769 | 98,586 | 1.27 | 70.72 |
| 1938 [1] | 806,000 | 148,000,000 | 1,087,000,000 | 1,418 | 73,515 | 1.30 | 67.63 |

[1] Subject to revision.

## EMPLOYMENT AND ACCIDENTS

### BITUMINOUS-COAL MINES

*Employment.*—The number of workers and number of man-hours worked in bituminous-coal mining, which employs more men than all other branches of the mineral industry of the United States combined, dropped in 1938 compared with 1937. Although final figures

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are not available for either year, reports thus far received from producing companies representing 60 percent of the industry indicate that the number of employees, which was 482,500 in 1936, rose to 507,000 in 1937 then fell to 469,000 in 1938—a loss of 30,000 or more employees in 1938 from the number working in 1937. The loss in man-hours worked at the mines was even more severe. The indicated number of man-hours worked in 1938 was 527 million, a loss of 24 percent from the tentative figure of 690 million for 1937 and of 21 percent from the final figure of 670 million for 1936. The corresponding drop in production of coal below 1937 was about 23 percent. An average of 160 workdays per man is indicated by the reports for 1938—a loss of 35 days per man compared with 1937.

*Accidents.*—The number of accidents to the mine workers in 1938 dropped sharply to 39,000 disabling injuries and 900 fatalities from 54,000 disabling injuries and 1,198 fatalities in 1937. The accident-frequency rate per million man-hours of employment or exposure to hazard was 75.7 compared with 80.3 in 1937 and 77.0 in 1936. Should these figures stand without material change when final figures for 1937 and 1938 become available, they will show that the safety record in 1938 was more favorable for the coal-mine workers than in any year since 1930 when, for the first time, complete reports of fatal and nonfatal injuries were collected for the industry.

### ANTHRACITE MINES

*Employment.*—Although the number of employees at anthracite mines in Pennsylvania decreased only slightly (about 4 percent) in 1938 according to final reports for 1937 and an estimate based upon incomplete returns from the operating companies for 1938, a more severe decline (about 15 percent) occurred in the total man-hours worked in 1938. According to final and complete reports for 1937, 99,085 men were working at the mines, preparation plants, and breakers in that year. Preliminary returns that cover about 62 percent of the industry indicate that this number apparently declined to about 95,000 in 1938, but final returns may raise the figure slightly. A total of 116 million man-hours were worked in 1938, according to present estimates, compared with 136 million man-hours in 1937. The average period of employment was only 174 days per worker in 1938, a loss of 15 work days per man from the 1937 average.

*Accidents.*—The recession in employment at anthracite mines in 1938 was accompanied by a reduction in the number of injuries resulting from accidents to the workers. However, the decreased number of accidents did not keep pace with the decline in employment; therefore, the accident rate per unit of employment was less favorable than in 1937. The rate for fatal and nonfatal accidents in 1937 was 115.2 per million man-hours of work; this rate increased slightly in 1938 and, according to preliminary data, reached 118.9 per million man-hours. Both years, however, had more favorable rates than 1936, when the rate was 123.4.

### IRON-ORE MINES

*Employment.*—Measured by the number of man-hours worked, employment at iron-ore mines decreased decidedly in 1938. The number of man-hours of work performed declined 39 percent, com-

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pared with 1937, according to reports now available which cover about 92 percent of all employees in the industry. The drop in man-hours worked was more severe for open-cut mining (57 percent) than for underground operations (35 percent). The decline in number of employees was much less severe. A 22-percent reduction was indicated in the total number of workers—the net result of a decline of 12 percent for underground employees, 48 percent for men at open-cut mines, and 16 percent for surface employees. A loss was also reported in the number of workdays per employee in 1938, the figure being tentatively set at 194 days in 1938 compared with 249 days in 1937 and 232 days in 1936.

*Accidents.*—Accidents were strikingly fewer, and in proportion to employment in 1938, only about one-third as many men were injured as in 1937. The tentative rate for 1938 shows only 16.1 fatal and nonfatal injuries per million man-hours worked compared with 30.8 in 1937 and 25.9 in 1936.

### COPPER MINES

*Employment.*—Although much copper is produced by mines whose ores are valuable chiefly for some other metal, the employment and accident figures of the Bureau of Mines cover only mines whose ores are valuable primarily for their copper content. It is manifestly impossible to segregate employment and accident data for a mine according to the various kinds of metal contained in the ores that the mine produces. Mines whose chief output was copper employed approximately 17,800 men in 1938, according to reports from companies whose employees represent about 91 percent of the total number of men working at all copper mines. This indicates a decrease of 16 percent from the number of men employed in 1937 but a gain of 26 percent over 1936. The prevailing working time was 8 hours a day, and the total number of man-shifts worked at all mines averaged 243 workdays per man, a loss of 64 days per man from 1937.

*Accidents.*—Marked progress was made in the prevention of accidents in copper mines in 1938, the accident-frequency rate being much lower than that for either 1937 or 1936. The indicated rate for 1938 was 56.3 per million man-hours of employment compared with 95.9 for 1937 and 81.9 for 1936. The actual number of injuries to the employees in 1938 was considerably less than in 1937 owing mainly to the fact that fewer men were working and partly to the fact that the workyear was shorter in 1938. The reports from the operators showed, however, that accidents decreased faster than employment, hence the improvement shown as a reduction in the accident rate per million man-hours of employment.

### LEAD AND ZINC MINES (MISSISSIPPI VALLEY STATES)

*Employment.*—Measured by the number of man-hours worked, employment at lead and zinc mines in the Mississippi Valley States declined about 25 percent in 1938, according to operating companies' reports to the Bureau of Mines covering about 58 percent of the employees at the mines. On the other hand, the number of men working was only about 9 percent less than in 1937. In contrast, the working force in 1938 represented a gain of 17 percent compared with 1936. The workyear was comparatively short, consisting of



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only 201 days per man in 1938, according to information now available, compared with a tentative figure of 240 days for 1937 and a final figure of 226 days for 1936.

These figures are for lead and zinc mines only; they do not include data for fluorspar mines in Illinois and Kentucky, which are sometimes combined with lead and zinc mines in the Mississippi Valley States.

*Accidents.*—A small increase was reported in the accident-frequency rate for lead-zinc mines in 1938, but it may not be sustained when complete reports from all producing companies have been received. The estimated rate for 1938 per million man-hours worked, based upon reports thus far furnished, was 61.5 compared with 60.4 for 1937. Both rates are higher than the rate of 54.6 for 1936.

### GOLD AND SILVER MINES

*Employment.*—This group comprises mines that produced ores containing any one or more of the five major metals—gold, silver, copper, lead, and zinc—except mines whose output was valuable chiefly for the copper content of the ore and mines in the Mississippi Valley States operated for lead or zinc. The category therefore includes lead-zinc mines in all States outside of the Mississippi Valley region and mines whose ores, although containing some copper, were valuable chiefly for some other metal. Placer as well as lode mines are included.

From a total of 47,967 employees in 1936 the number rose to an estimated 52,000 in 1937 and remained virtually the same in 1938, according to reports from many, but not all, operating companies. However, the amount of employment per worker was less in 1938 than in either 1936 or 1937, as the smaller number of man-hours shows. The total volume of employment was 93 million man-hours in 1936 and, according to reports now available, about 94 million in 1937 and 91 million in 1938. Each employee, excluding those at placer mines, averaged 259 working days in 1936 compared with an estimated 239 days in 1937 and 241 days in 1938. The average working time per employee at placer operations cannot be given for 1937 and 1938 at this time but was 174 days in 1936.

*Accidents.*—The accident rate for this group of mines has been increasing during the past 3 years. The combined rate for lode and placer mines was 94.8 in 1936 and, according to data now available, increased to 107.8 in 1937 and 111.1 in 1938.

### MISCELLANEOUS METAL MINES

*Employment.*—This group covers all mines whose ores were valuable chiefly for their content of some metal other than gold, silver, copper, lead, zinc, or iron. It therefore comprises mines that produced quicksilver, tungsten, manganese, and various other metals. Approximately 3,600 men were working in mines of this group in 1938, according to information in reports from companies whose workers include about half of all employees at such mines. The number of men working was 22 percent less than in 1937 but 10 percent more than in 1936. The average number of days worked per man was 244 in 1938, indicating a loss of 17 workdays per man compared with 1937, but a gain of 4 days per man compared with 1936.

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*Accidents.*—The accident-frequency rate for this group of mines was not as favorable in 1938 as in 1937. Present reports indicate that the 1938 rate was 71.9. Reports for 1937 showed a rate of 63.7 and for 1936 of 89.1.

### NONMETALLIC-MINERAL MINES

*Employment.*—The number of men working at nonmetallic-mineral mines in 1938 decreased about 8 percent from 1937. A more serious reduction in employment was indicated by the total number of man-hours worked, which was 14 percent less than in 1937. These declines are based on reports from companies representing about 54 percent of all employees at mines in this group. The total working time for all employees averaged 239 days per man compared with 254 days per man during 1937. Mines in this group comprise all classes of nonmetallic mines, including those that produced phosphate rock, fluorspar, gypsum, salt, sulfur, or any of various other nonmetallic minerals.

*Accidents.*—Accidents in these mines declined also, and the decrease in number of accidents was proportionately greater than that in number of employees. Therefore the accident-frequency rate was more favorable in 1938 than in 1937. Tentative figures show an accident rate of 39.7 for 1938 compared with 47.5 for 1937 and 50.7 for 1936.

### CEMENT MILLS AND QUARRIES

*Employment.*—A slight increase in number of workers was reported for cement mills and quarries in 1938, but there were reductions in the total number of man-hours worked and in the average number of workdays per employee. On the basis of reports from companies representing about 89 percent of the total number of workers, the industry as a whole employed about 27,600 men compared with 27,215 in 1937. The estimated number of man-hours worked was 48 million compared with 56 million in 1937. An average of 236 workdays per man was indicated for 1938, a reduction of 42 days per man from the average for 1937.

*Accidents.*—That progress was made in the prevention of accidents in 1938 was shown by a reduction in the accident-frequency rate from 12.2 in 1937 to 9.7 in 1938. This low accident rate for cement mills and quarries was the most favorable one reported by any branch of the mineral industry in 1938 except byproduct coke ovens, whose rate was 7.5.

### MARBLE QUARRIES

*Employment.*—Reports from companies representing about 88 percent of the total number of men working in and about marble quarries showed that the entire industry employed approximately 3,400 men in 1938, a reduction of about 7 percent from the 3,647 men employed in 1937. The total number of man-hours worked declined 5 percent to 6.5 million man-hours in 1938 from 6.9 million man-hours in 1937. The loss of 7 percent in number of workers and of only 5 percent in man-hours worked indicated a slight gain for the average worker in the number of workdays available during the year; the working time averaged 235 days per man in 1938 compared with 230 days per man in 1937.

*Accidents.*—In spite of a slight loss in total man-hours of employment accidents increased, both in number and in relation to volume

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of employment. Tentative figures show an accident-frequency rate of 58.3 per million man-hours worked in 1938 compared with 50.9 in 1937.

### SLATE QUARRIES

*Employment.*—Reports representing approximately 71 percent of all men employed at slate quarries in the United States indicate that the industry had 2,600 employees in 1938, or 15 percent less than in 1937. This decline in the number of employees was accompanied by a larger decline in the number of man-hours worked. Tentative figures show a total of 4.1 million man-hours of employment, a reduction of 32 percent from the 6.0 million man-hours in 1937. A large reduction also was reported in the average working time per man, which fell from 232 days in 1937 to 186 days in 1938.

*Accidents.*—The decline in number of accidents in 1938 was not as great as the drop in employment, hence the accident-frequency rate increased from 56.9 in 1937 to 62.1 in 1938.

### TRAP-ROCK QUARRIES

*Employment.*—There was virtually no change in the number of men working at trap-rock quarries in 1938 compared with 1937. Moreover, only a slight reduction (about 4 percent) was indicated in the number of man-hours worked in 1938. The industry employed 2,806 men in 1937, and tentative reports show 2,770 men employed in 1938. Measured in man-hours, employment was 4.3 million in 1938 compared with 4.5 million in 1937. The average working time per man was 192 days in 1937 and apparently did not change in 1938.

*Accidents.*—The accident-frequency rate dropped notably in 1938 from the strikingly high figure for 1937, the tentative rate for 1938 being 44.7 per million man-hours compared with the final rate of 75.8 for 1937. The rate for 1936 was 60.3.

### GRANITE QUARRIES

*Employment.*—Reports from operators of granite quarries that employ approximately 56 percent of all men working in the industry indicate a reduction of 8 percent in number of workers and 15 percent in number of man-hours worked in 1938 compared with 1937. The number of workers was 8,961 in 1937 but declined to about 8,200 in 1938, according to reports thus far received. All workers were employed approximately 13.6 million man-hours in 1938 compared with 16.1 million in 1937. Returns now available indicate a total of 210 workdays per man in 1938 compared with 226 days in 1937 and 224 days in 1936.

*Accidents.*—Marked progress was made in the prevention of accidents in 1938, as was shown by a substantial reduction in the number of accidents to employees and in the accident-frequency rate per million man-hours worked. The indicated rate for 1938 was 38.4 compared with 54.0 for 1937 and 52.2 for 1936.

### SANDSTONE QUARRIES

*Employment.*—Losses in the number of men working and the number of man-hours worked were shown by returns from operators

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of sandstone quarries in 1938. The industry apparently employed a little more than 2,700 men, or about 15 percent less than in 1937, and worked about 3.6 million man-hours—35 percent less than in 1937. The average employee worked 159 days in 1938, the corresponding figure for 1937 being 204 and for 1936, 201.

*Accidents.*—Substantial improvement was reported in the elimination of accidental injuries to employees in 1938. Not only was the actual number of injuries reduced, but also the accident rate was more favorable in relation to volume of employment than in 1937. A tentative rate of 39.4 accidents per million man-hours was shown by reports for 1938 compared with 75.3 for 1937 and 48.2 for 1936.

### LIMESTONE QUARRIES

*Employment.*—This group of operations covers all limestone quarries except those whose product is used chiefly for the manufacture of cement or lime. According to reports from companies whose employees comprise about 49 percent of all workers in the industry, the number of men employed in and about the quarries has remained fairly stationary during the past 3 years. The number of men working is estimated at 24,900 in 1938 compared with 24,789 in 1937 and 24,288 in 1936. Although the number of workers remained about the same, reports thus far received for 1938 indicate that the number of man-hours declined 16 percent below 1937 and 11 percent below 1936. Moreover, the average working period per employee apparently was only about 174 days in 1938, or 28 days less than in 1937 and 20 days less than in 1936.

*Accidents.*—Based on data now available, the accident-frequency rate for limestone quarries increased in 1938 to an estimated 59.8 accidents per million man-hours of employment. In 1937 the rate was 53.9, and in 1936 it was 55.0.

### LIMEKILNS AND QUARRIES

*Employment.*—A drop of 18 percent in number of employees and 27 percent in man-hours worked was indicated for 1938 by reports received from companies operating limekilns and quarries. The working force comprised 8,500 men compared with 10,360 men in 1937, and the period of employment for the industry as a whole was 16.5 million man-hours in 1938 compared with 22.5 million man-hours in 1937. A loss of about 25 working days per employee from the 281 days in 1937 was shown by the reports for 1938.

*Accidents.*—A little progress was made in the prevention of accidents in 1938. The indicated rate for the year is 52.2 accidents per million man-hours worked compared with 54.7 in both 1937 and 1936.

### BYPRODUCT-COKE OVENS

*Employment.*—The number of men employed in the byproduct-coking industry of the United States fell 30 percent and the number of man-hours worked dropped 31 percent during 1938 according to reports from companies that represented approximately 97 percent of the total number of workers at all plants. The average working period was 347 days per man in 1938 compared with 360 days in 1937 and 365 days in 1936. These figures as to the length of the work year

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do not imply that any given employee worked the number of days indicated; rather they mean that the ovens averaged the indicated number of workdays for the "average" employee. The word "average" here signifies the mathematical mean, or the quotient obtained by dividing the total number of man-days by the total number of oven-days at each operation.

*Accidents.*—The accident-frequency rate for the byproduct-coking industry was more favorable than the corresponding rate for any other major group of the mineral industry, including mines, quarries, coke ovens, and metallurgical plants. Available reports for 1938 indicate an accident-frequency rate for this class of ovens of about 7.5 per million man-hours worked. The excellence of the safety record shown by this low rate may be seen by comparing it with an average rate of 68.9 for all mineral industries combined. The rate for by-product ovens in 1937 was 8.5, and that in 1936 was 8.7.

### BEEHIVE-COKE OVENS

*Employment.*—After increasing from 1,525 men in 1936 to 2,192 men in 1937, the number of employees at beehive-coke ovens in the United States dropped to 1,200 in 1938, according to reports from operating companies whose employees comprise about 62 percent of the total number at this class of ovens. Compared with 1937 the reduction in number of workers in 1938 was 46 percent. The number of man-hours worked at all ovens decreased 63 percent—from 3.28 million in 1937 to only 1.23 million in 1938. The average working time per employee was 150 days in 1938 compared with 213 days in 1937 and 183 days in 1936.

*Accidents.*—The decline in employment was accompanied by a gratifying reduction in the accident-frequency rate and in the actual number of injuries to the employees. An estimate for 1938 indicates an accident rate of 28.4 per million man-hours of employment, compared with the rate of 48.5 for 1937 and 36.0 for 1936.

### ORE-DRESSING PLANTS

*Employment.*—A reduction of about 25 percent in number of employees at ore-dressing plants in the United States was indicated by reports for 1938 from companies that employ approximately 48 percent of the total number of workers in this branch of the mineral industry. The number of man-hours of work done during the year declined 37 percent. Available reports indicate that the total number of men employed in 1938 was 11,400 compared with 15,300 in 1937, and that the man-hours of labor performed totaled 20.5 million in 1938 as against 32.7 million in 1937. The average employee worked 226 days in 1938, or 42 days per man less than in 1937.

*Accidents.*—The accident rate was more favorable in 1938 than in 1937, as was also the actual number of men injured. The tentative rate for 1938 was 27.8 per million man-hours of employment compared with 33.8 for 1937 and 29.7 for 1936.

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### SMELTERS

*Employment.*—Employment at smelters in the United States declined 19 percent in 1938 when measured by the number of men working and 22 percent when measured by the number of man-hours worked. Reports that covered approximately 88 percent of the workers at all establishments showed that the smelting industry as a whole employed about 14,400 men who worked a total of 35.1 million man-hours in 1938 as compared with 17,900 men who worked 45.2 million man-hours in 1937.

*Accidents.*—The accident-frequency rate for 1938 was more favorable than that for 1937 and about the same as the rate for 1936. The indicated rate for 1938 was 19.9 accidents per million man-hours worked, while that for 1937 was 22.8 and for 1936, 20.6.

### AUXILIARY WORKS AT ORE-DRESSING PLANTS AND SMELTERS

*Employment.*—Employment at ore-dressing plants and smelters, covering employees not directly connected with milling and smelting processes, was somewhat less in 1938 than in 1937 but did not differ materially from that in 1936. An estimate based upon reports from companies representing about 81 percent of all workers indicated a total of 12,200 men employed in 1938, about 2,700 less than in 1937. Final reports for 1936 showed a total of 12,004 men employed. The number of man-hours worked was 29 million compared with 38 million in 1937 and 30 million in 1936. Employment averaged 299 days per man in 1938. In 1937 the average was 320 days per man, while in 1936 it was 318 days.

*Accidents.*—The safety record was more favorable in 1938 than in either 1937 or 1936. The actual number of persons injured was much below that of either 1936 or 1937. According to reports now available, the accident-frequency rate per million man-hours worked was 16.1, which compares favorably with rates of 26.9 for 1937 and 18.5 for 1936.

## SUMMARY, 1931–38

Bureau of Mines records of the number of man-hours of work performed in all branches of the mining and quarrying industries were compiled first for the calendar year 1931. Figures giving this information, as well as accident rates, for 1931–38, are shown in a preceding table.

The period 1931–38 included the year 1932, when employment in the mining and allied industries in the United States reached its lowest point. From 1932 to 1937 employment increased uninterruptedly, but in 1938 some of the previous gains were lost.

If the record for 1932, the low point of the depression, is chosen as a basis for comparison and is represented by an index of 100, the improvement in 1937 and 1938 may easily be seen. With an index of 100 for 1932, the number of men employed in 1937 would be represented by an index of 131, an increase of 31 percent over 1932, and the number of workers on the rolls in 1938 by 120, or 20 percent higher than in 1932. The index of man-hours worked reached 155 in 1937 and dropped back to 121 in 1938.

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Owing to the greater volume of employment in 1937 and 1938 than in 1932, accidents also increased in number but not as fast as employment, hence the accident-frequency rate declined in relation to volume of employment. The actual number of accidents raised the index to 143 in 1937 and 107 in 1938. As these indexes were smaller than those for man-hours, it follows that the accident rates for 1937 and 1938 were more favorable than the rate for 1932. The accident rate per million man-hours in 1932, the base year, was 77.9. This rate was lowered to 72.0 in 1937 and 68.9 in 1938. The rate for 1938 was the lowest since records of accidents in relation to man-hours of exposure to occupational hazards first became available for the mineral industry of the United States in 1931.

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